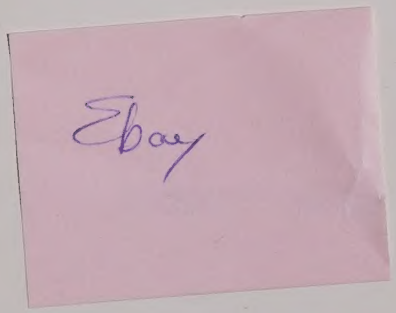
GPIB

NI-488.2M™ Function Reference Manual for Win32



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GPIB

NI-488.2M™ Function Reference Manual for Win32

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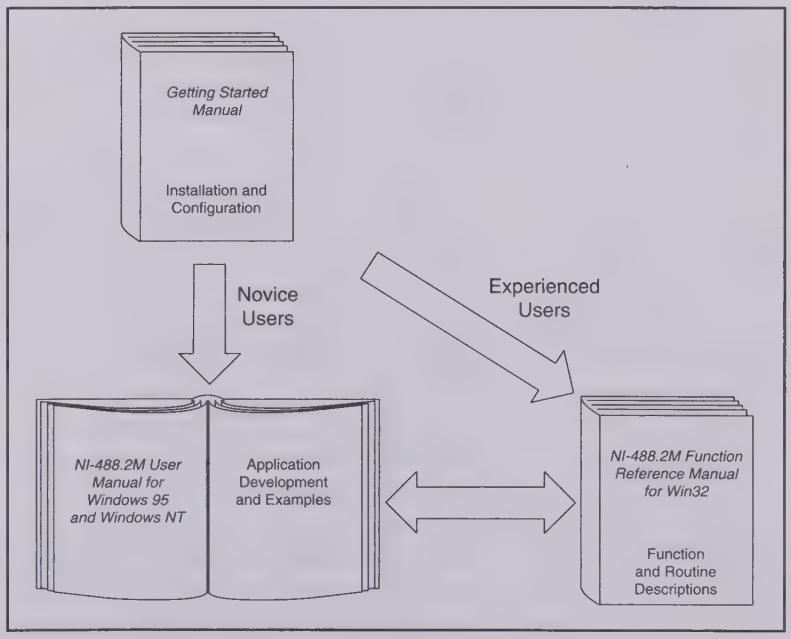
About This Manual

This manual describes the NI-488 functions and NI-488.2 routines of the NI-488.2M software for Windows 95 and Windows NT. The NI-488.2M software for Windows 95 is meant to be used with Windows 95 version 4.0 or higher. The NI-488.2M software for Windows NT is meant to be used with Windows NT version 3.1 or higher and the Microsoft Windows NT Advanced Server version 3.1 or higher. This manual assumes that you are already familiar with the Win32 system you are using.

How to Use The Manual Set


Getting Started Manual
Installation and Configuration
Novice Users
Experienced Users
NI-488.2M User Manual for Windows 95 and Windows NT
Application Development and Examples
NI-488.2M Function Reference Manual for Win32
Function and Routine Descriptions

Use the getting started manual to install and configure your GPIB hardware and NI-488.2M software.

Use the *NI-488.2M User Manual for Windows 95 and Windows NT* if you want to learn the basics of GPIB and how to develop an application. The user manual also contains debugging information and detailed examples.

Use the *NI-488.2M Function Reference Manual for Win32* for specific information about each NI-488 function and NI-488.2 routine such as format, parameters, and possible errors.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *NI-488 Functions,* lists the NI-488 functions and describes the purpose, format, input and output parameters, and possible errors for each function.
- Chapter 2, *NI-488.2 Routines,* lists the NI-488.2 routines and describes the purpose, format, input and output parameters, and possible errors for each routine.
- Chapter 3, *Functions for Multithreaded Applications,* lists the extra functions designed for multithreaded applications and describes the purpose, format, and input and output parameters for each function.
- Appendix A, *Multiline Interface Messages*, contains a multiline interface message reference list, which describes the mnemonics and messages that correspond to the interface functions.
- Appendix B, *Status Word Conditions*, gives a detailed description of the conditions reported in the status word, `ibsta`.
- Appendix C, *Error Codes and Solutions*, lists a description of each error, some conditions under which it might occur, and possible solutions.
- Appendix D, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.
- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.
- The *Index* contains an alphabetical list of key terms and topics in this manual, including the page where you can find each one.

Conventions Used in This Manual

The following conventions are used in this manual.

-	A hyphen between two or more key names enclosed in angle brackets denotes that you should simultaneously press the named keys—for example, <Control-Alt-Delete>.
bold italic	Bold italic text denotes a note, caution, or warning.
IEEE 488 and IEEE 488.2	*IEEE 488* and *IEEE 488.2* refer to the ANSI/IEEE Standard 488.1-1987 and the ANSI/IEEE Standard 488.2-1992, respectively, which define the GPIB.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
`monospace`	Text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, constants, variables, filenames, and extensions, and for statements and comments taken from program code.
NI-488.2M software	*NI-488.2M software* refers generically to either the NI-488.2M software for Windows 95 or the NI-488.2M software for Windows NT, unless otherwise noted.

Abbreviations, acronyms, metric prefixes, mnemonics, symbols, and terms are listed in the *Glossary*.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*
- ANSI/IEEE Standard 488.2-1992, *IEEE Standard Codes, Formats, Protocols, and Common Commands*
- The Win32 SDK that came with your computer

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix D, *Customer Communication*, at the end of this manual.

Chapter 1

NI-488 Functions

This chapter lists the NI-488 functions and describes the purpose, format, input and output parameters, and possible errors for each function.

For general programming information, refer to the NI-488.2M user manual. The user manual explains how to develop and debug your program. It also describes the example programs included with your NI-488.2M software.

Function Names

The functions in this chapter are listed alphabetically. Each function is designated as board level, device level, or both.

Purpose

Each function description includes a brief statement of the purpose of the function.

Format

The format section describes the format of each function in the following languages: Microsoft Visual C/C++ (version 2.0 or higher), Borland C/C++ (version 4.0 or higher), and Microsoft Visual Basic (version 4.0 or higher)

Input and Output

The input and output parameters for each function are listed. Function Return describes the return value of the function.

Description

The description section gives details about the purpose and effect of each function.

Examples

Some function descriptions include sample code showing how to use the function. For more detailed and complete examples, refer to the example programs that are included with your NI-488.2M software. The example programs are described in Chapter 2 of the NI-488.2M user manual.

Possible Errors

Each function description includes a list of errors that could occur when it is invoked.

List of NI-488 Functions

The following tables contain an alphabetical list of the NI-488 functions.

Table 1-1. NI-488 Device-Level Functions

Function	Purpose
ibask	Return information about software configuration parameters
ibbna	Change the access board of a device
ibclr	Clear a specific device
ibconfig	Change the software configuration parameters
ibdev	Open and initialize a device
ibeos	Configure the end-of-string (EOS) termination mode or character
ibeot	Enable or disable the automatic assertion of the GPIB EOI line at the end of write I/O operations
ibln	Check for the presence of a device on the bus
ibloc	Go to local
ibnotify	Notify user of one or more GPIB events by invoking the user callback
ibonl	Place the device online or offline
ibpad	Change the primary address
ibpct	Pass control to another GPIB device with Controller capability
ibppc	Parallel poll configure
ibrd	Read data from a device into a user buffer
ibrda	Read data asynchronously from a device into a user buffer
ibrdf	Read data from a device into a file
ibrpp	Conduct a parallel poll
ibrsp	Conduct a serial poll
ibsad	Change or disable the secondary address

(continues)

Table 1-1. NI-488 Device-Level Functions (Continued)

Function	Purpose
ibstop	Abort asynchronous I/O operation
ibtmo	Change or disable the I/O timeout period
ibtrg	Trigger selected device
ibwait	Wait for GPIB events
ibwrt	Write data to a device from a user buffer
ibwrta	Write data asynchronously to a device from a user buffer
ibwrtf	Write data to a device from a file

Table 1-2. NI-488 Board-Level Functions

Function	Purpose
ibask	Return information about software configuration parameters
ibcac	Become Active Controller
ibcmd	Send GPIB commands
ibcmda	Send GPIB commands asynchronously
ibconfig	Change the software configuration parameters
ibdma	Enable or disable DMA
ibeos	Configure the end-of-string (EOS) termination mode or character
ibeot	Enable or disable the automatic assertion of the GPIB EOI line at the end of write I/O operations
ibfind	Open and initialize a GPIB board
ibgts	Go from Active Controller to Standby
ibist	Set or clear the board individual status bit for parallel polls
iblines	Return the status of the eight GPIB control lines
ibln	Check for the presence of a device on the bus
ibloc	Go to local
ibnotify	Notify user of one or more GPIB events by invoking the user callback

(continues)

Table 1-2. NI-488 Board-Level Functions (Continued)

Function	Purpose
ibonl	Place the interface board online or offline
ibpad	Change the primary address
ibppc	Parallel poll configure
ibrd	Read data from a device into a user buffer
ibrda	Read data asynchronously from a device into a user buffer
ibrdf	Read data from a device into a file
ibrpp	Conduct a parallel poll
ibrsc	Request or release system control
ibrsv	Request service and change the serial poll status byte
ibsad	Change or disable the secondary address
ibsic	Assert interface clear
ibsre	Set or clear the Remote Enable (REN) line
ibstop	Abort asynchronous I/O operation
ibtmo	Change or disable the I/O timeout period
ibwait	Wait for GPIB events
ibwrt	Write data to a device from a user buffer
ibwrta	Write data asynchronously to a device from a user buffer
ibwrtf	Write data to a device from a file

IBASK

Board Level/Device Level

IBASK

Purpose

Return information about software configuration parameters.

Format

C

```
int ibask (int ud, int option, int *value)
```

Visual Basic

```
CALL ibask (ud%, option%, value%)
```

or

```
status% = ilask (ud%, option%, value%)
```

Input

ud	Board or device unit descriptor
option	Selects the configuration item whose value is being requested

Output

value	Current value of the selected configuration item
Function Return	The value of ibsta

Description

ibask returns the current value of various configuration parameters for the specified board or device. The current value of the selected configuration item is returned in the integer value. Table 1-3 and Table 1-4 list the valid configuration parameter options for ibask.

Possible Errors

EARG	option is not a valid configuration parameter. See the ibask options listed in Table 1-3 and Table 1-4.
ECAP	option does not work with the driver or the board is not configured correctly.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.

IBASK Board Level/Device Level IBASK
(Continued)

Table 1-3 lists the options you can use with `ibask` when `ud` is a board descriptor or a board index. The following is an alphabetical list of the option constants.

- `IbaAUTOPOLL`
- `IbaCICPROT`
- `IbaDMA`
- `IbaEndBitIsNormal`
- `IbaEOSchar`
- `IbaEOScmp`
- `IbaEOSrd`
- `IbaEOSwrt`
- `IbaEOT`
- `IbaHSCableLength`
- `IbaIst`
- `IbaPAD`
- `IbaPP2`
- `IbaPPC`
- `IbaPPollTime`
- `IbaReadAdjust`
- `IbaRsv`
- `IbaSAD`
- `IbaSC`
- `IbaSendLLO`
- `IbaSRE`
- `IbaTIMING`
- `IbaTMO`
- `IbaWriteAdjust`

Table 1-3. ibask Board Configuration Parameter Options

Options (Constants)	Returned Information
`IbaAUTOPOLL`	zero = Automatic serial polling is disabled. non-zero = Automatic serial polling is enabled. Refer to the NI-488.2M user manual for more information about automatic serial polling.
`IbaCICPROT`	zero = The CIC protocol is disabled. non-zero = The CIC protocol is enabled. Refer to the NI-488.2M user manual for more information about device-level calls and bus management.
`IbaDMA`	zero = The board does not use DMA for GPIB transfers. non-zero = The board does use DMA for GPIB transfers. See `ibdma`.
`IbaEndBitIsNormal`	zero = The END bit of `ibsta` is set only when EOI or EOI plus the EOS character is received. If the EOS character is received without EOI, the END bit is not set. non-zero = The END bit is set whenever EOI, EOS, or EOI plus EOS is received.

(continues)

Table 1-3. ibask Board Configuration Parameter Options (Continued)

Options (Constants)	Returned Information
IbaEOSchar	The current EOS character of the board. See ibeos.
IbaEOScmp	zero = A 7-bit compare is used for all EOS comparisons. non-zero = An 8-bit compare is be used for all EOS comparisons. See ibeos.
IbaEOSrd	zero = The EOS character is ignored during read operations. non-zero = Read operation is terminated by the EOS character. See ibeos.
IbaEOSwrt	zero = The EOI line is not asserted when the EOS character is sent during a write operation. non-zero = The EOI line is asserted when the EOS character is sent during a write operation. See ibeos.
IbaEOT	zero = The GPIB EOI line is not asserted at the end of a write operation. non-zero = EOI is asserted at the end of a write. See ibeot.
IbaHSCableLength	0 = High-speed (HS488) data transfer is disabled. 1 to 15 = High-speed (HS488) data transfer is enabled. The number returned represents the number of meters of GPIB cable in your system. See the NI-488.2M user manual for information about high-speed (HS488) data transfer.
IbaIst	The individual status (ist) bit of the board.
IbaPAD	The current primary address of the board. See ibpad.

(continues)

IBASK Board Level/Device Level IBASK
(Continued)

Table 1-3. ibask Board Configuration Parameter Options (Continued)

Options (Constants)	Returned Information
IbaPP2	zero = The board is in PP1 mode—remote parallel poll configuration. non-zero = The board is in PP2 mode—local parallel poll configuration. Refer to the NI-488.2M user manual for more information about parallel polls.
IbaPPC	The current parallel poll configuration information of the board. See ibppc.
IbaPPollTime	0 = The board uses the standard duration (2 µs) when conducting a parallel poll. 1 to 17 = The board uses a variable length duration when conducting a parallel poll. The duration values correspond to the ibtmo timing values.
IbaReadAdjust	0 = Read operations do not have pairs of bytes swapped. 1 = Read operations do have each pair of bytes swapped.
IbaRsv	The current serial poll status byte of the board.
IbaSAD	The current secondary address of the board. See ibsad.
IbaSC	zero = The board is not the GPIB System Controller. non-zero = The board is the System Controller. See ibrsc.
IbaSendLLO	zero = The GPIB LLO command is not sent when a device is put online—ibfind or ibdev. non-zero = The LLO command is sent.
IbaSRE	zero = The board does not automatically assert the GPIB REN line when it becomes the System Controller. non-zero = The board automatically asserts REN when it becomes the System Controller. See ibrsc and ibsre.
IbaTIMING	The current bus timing of the board. 1 = Normal timing (T1 delay of 2 µs). 2 = High speed timing (T1 delay of 500 ns). 3 = Very high speed timing (T1 delay of 350 ns).

(continues)

Table 1-3. Ibask Board Configuration Parameter Options (Continued)

Options (Constants)	Returned Information
IbaTMO	The current timeout period of the board. See ibtmo.
IbaWriteAdjust	0 = Write operations do not have pairs of bytes swapped. 1 = Write operations do have each pair of bytes swapped.

Table 1-4 lists the options you can use with ibask when ud is a device descriptor or a device index. The following is an alphabetical list of the option constants.

- IbaBNA
- IbaEOSchar
- IbaEOScmp
- IbaEOSrd
- IbaEOSwrt
- IbaEOT
- IbaPAD
- IbaReadAdjust
- IbaREADDR
- IbaSAD
- IbaSPollTime
- IbaTMO
- IbaUnAddr
- IbaWriteAdjust

Table 1-4. ibask Device Configuration Parameter Options

Options (Constants)	Returned Information
IbaBNA	The index of the GPIB access board used by the given device descriptor.
IbaEOSchar	The current EOS character of the device. See ibeos.

(continues)

IBASK Board Level/Device Level IBASK (Continued)

Table 1-4. ibask Device Configuration Parameter Options (Continued)

Options (Constants)	Returned Information
IbaEOScmp	zero = A 7-bit compare is used for all EOS comparisons. non-zero = An 8-bit compare is used for all EOS comparisons. See ibeos.
IbaEOSrd	zero = The EOS character is ignored during read operations. non-zero = Read operation will be terminated by the EOS character. See ibeos.
IbaEOSwrt	zero = The EOI line is not asserted when the EOS character is sent during a write operation. non-zero = The EOI line is asserted when the EOS character is sent during a write. See ibeos.
IbaEOT	zero = The GPIB EOI line is not asserted at the end of a write operation. non-zero = EOI is asserted at the end of a write. See ibeot.
IbaPAD	The current primary address of the device. See ibpad.
IbaReadAdjust	0 = Read operations do not have pairs of bytes swapped. 1 = Read operations do have each pair of bytes swapped.
IbaREADDR	zero = No unnecessary addressing is performed between device-level read and write operations. non-zero = Addressing is always performed before a device-level read or write operation.
IbaSAD	The current secondary address of the device. See ibsad.
IbaSPollTime	The length of time the driver waits for a serial poll response when polling the device. The length of time is represented by the ibtmo timing values.

(continues)

Table 1-4. ibask Device Configuration Parameter Options (Continued)

Options (Constants)	Returned Information
IbaTMO	The current timeout period of the device. See ibtmo.
IbaUnAddr	zero = The GPIB commands Untalk (UNT) and Unlisten (UNL) are not sent after each device-level read and write operation. non-zero = The UNT and UNL commands are sent after each device-level read and write.
IbaWriteAdjust	0 = Write operations do not have pairs of bytes swapped. 1 = Write operations do have each pair of bytes swapped.

IBBNA Device Level IBBNA

Purpose

Change the access board of a device.

Format

C

```
int ibbna (int ud, char *bname)
```

Visual Basic

```
CALL ibbna (ud%, bname$)
```

or

```
status% = ilbna (ud%, bname$)
```

Input

ud	A device unit descriptor
bname	An access board name such as GPIB0

Output

Function Return	The value of ibsta

Description

ibbna assigns the device described by ud to the access board described by bname. All subsequent bus activity with device ud occurs through the access board bname. If the call succeeds iberr contains the previous access board index.

Possible Errors

EARG	Either ud does not refer to a device or bname does not refer to a valid board name.
ECIC	The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The access board is not installed or configured properly.
EOIP	Asynchronous I/O is in progress.

IBCAC Board Level IBCAC

Purpose

Become Active Controller.

Format

C

```
int ibcac (int ud, int v)
```

Visual Basic

```
CALL ibcac (ud%, v%)
```

or

```
status% = ilcac (ud%, v%)
```

Input

ud	A board unit descriptor
v	Determines if control is to be taken asynchronously or synchronously

Output

Function Return	The value of ibsta

Description

Using ibcac, the designated GPIB board attempts to become the Active Controller by asserting ATN. If v is zero, the GPIB board takes control asynchronously; if v is non-zero, the GPIB board takes control synchronously. Before you call ibcac, the GPIB board must already be CIC. To make the board CIC, use the ibsic function.

To take control synchronously, the GPIB board attempts to assert the ATN signal without corrupting transferred data. If this is not possible, the board takes control asynchronously.

To take control asynchronously, the GPIB board asserts ATN immediately without regard for any data transfer currently in progress.

Most applications do not need to use ibcac. Functions that require ATN to be asserted, such as ibcmd, do so automatically.

IBCAC Board Level IBCAC
(Continued)

Possible Errors

EARG	ud is valid but does not refer to an interface board.
ECIC	The interface board is not Controller-In-Charge.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBCLR Device Level IBCLR

Purpose

Clear a specific device.

Format

C

```
int ibclr (int ud)
```

Visual Basic

```
CALL ibclr (ud%)
```

or

```
status% = ilclr (ud%)
```

Input

ud	A device unit descriptor

Output

Function Return	The value of ibsta

Description

ibclr sends the GPIB Selected Device Clear (SDC) message to the device described by ud.

Possible Errors

EARG	ud is a valid descriptor but does not refer to a device.
EBUS	No devices are connected to the GPIB.
ECIC	The access board is not CIC. Refer to the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBCMD Board Level IBCMD

Purpose

Send GPIB commands.

Format

C

```
int ibcmd (int ud, void *cmdbuf, long count)
```

Visual Basic

```
CALL ibcmd (ud%, cmdbuf$)
```

or

```
status% = ilcmd (ud%, cmdbuf$, count&)
```

Input

ud	A board unit descriptor
cmdbuf	Buffer of command bytes to send
count	Number of command bytes to send

Output

Function Return	The value of ibsta

Description

ibcmd sends count bytes from cmdbuf over the GPIB as command bytes (interface messages). The number of command bytes transferred is returned in the global variable, ibcntl. Refer to Appendix A, *Multiline Interface Messages*, for a table of the defined interface messages.

Command bytes are used to configure the state of the GPIB. They are not used to send instructions to GPIB devices. Use ibwrt to send device-specific instructions.

IBCMD Board Level IBCMD
(Continued)

Possible Errors

EABO	The timeout period expired before all of the command bytes were sent.
EARG	ud is valid but does not refer to an interface board.
ECIC	The interface board is not Controller-In-Charge.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
ENOL	No Listeners are on the GPIB.
EOIP	Asynchronous I/O is in progress.

IBCMDA Board Level IBCMDA

Purpose

Send GPIB commands asynchronously.

Format

C

```
int ibcmda (int ud, void *cmdbuf, long count)
```

Visual Basic

```
CALL ibcmda (ud%, cmdbuf$)
```

or

```
status% = ilcmda (ud%, cmdbuf$, count&)
```

Input

ud	A board unit descriptor
cmdbuf	Buffer of command bytes to send
count	Number of command bytes to send

Output

Function Return	The value of ibsta

Description

ibcmda sends count bytes from cmdbuf over the GPIB as command bytes (interface messages). The number of command bytes transferred is returned in the global variable, ibcntl. Refer to Appendix A, *Multiline Interface Messages*, for a table of the defined interface messages.

Command bytes are used to configure the state of the GPIB. They are not used to send instructions to GPIB devices. Use ibwrt to send device-specific instructions.

The asynchronous I/O calls (ibcmda, ibrda, ibwrta) are designed so that applications can perform other non-GPIB operations while the I/O is in progress. Once the asynchronous I/O begins, further GPIB calls are strictly limited. Any calls that would interfere with the I/O in progress are not allowed; the driver returns EOIP in this case.

IBCMDA Board Level IBCMDA
(Continued)

Once the I/O is complete, the application must *resynchronize* with the NI-488.2M driver. Resynchronization is accomplished by using one of the following functions:

`ibnotify`	If the `ibsta` value passed to the `ibnotify` callback contains CMPL, then the driver and application are resynchronized.
`ibwait`	If the returned `ibsta` contains CMPL, then the driver and application are resynchronized.
`ibstop`	The I/O is canceled; the driver and application are resynchronized.
`ibonl`	The I/O is canceled and the interface is reset; the driver and application are resynchronized.

Possible Errors

EARG	`ud` is valid but does not refer to an interface board.
ECIC	The interface board is not Controller-In-Charge.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
ENOL	No Listeners are on the GPIB.
EOIP	Asynchronous I/O is in progress.

IBCONFIG — Board Level/Device Level — IBCONFIG

Purpose

Change the software configuration input.

Format

C

```
ibconfig (int ud, int option, int value)
```

Visual Basic

```
CALL ibconfig (ud%, option%, value%)
```

or

```
status% = ilconfig (ud%, option%, value%)
```

Input

ud	Board or device unit descriptor
option	A parameter that selects the software configuration item
value	The value to which the selected configuration item is to be changed

Output

Function Return	The value of ibsta

Description

ibconfig changes a configuration item to the specified value for the selected board or device. option may be any of the defined constants in Table 1-5 and value must be valid for the parameter that you are configuring. The previous setting of the configured item is returned in iberr.

Possible Errors

EARG	Either option or value is not valid. See Table 1-5.
ECAP	The driver is not able to make the requested change.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
EOIP	Asynchronous I/O is in progress.

IBCONFIG Board Level/Device Level IBCONFIG
(Continued)

Table 1-5 lists the options you can use with `ibconfig` when `ud` is a board descriptor or a board index. The following is an alphabetical list of the option constants.

- `IbcAUTOPOLL`
- `IbcCICPROT`
- `IbcDMA`
- `IbcEndBitIsNormal`
- `IbcEOSchar`
- `IbcEOScmp`
- `IbcEOSrd`
- `IbcEOSwrt`
- `IbcEOT`
- `IbcHSCableLength`
- `IbcIst`
- `IbcPAD`
- `IbcPP2`
- `IbcPPC`
- `IbcPPollTime`
- `IbcReadAdjust`
- `IbcRsv`
- `IbcSAD`
- `IbcSC`
- `IbcSendLLO`
- `IbcSRE`
- `IbcTIMING`
- `IbcTMO`
- `IbcWriteAdjust`

Table 1-5. ibconfig Board Configuration Parameter Options

Options (Constants)	Legal Values
`IbcAUTOPOLL`	zero = Disable automatic serial polling. non-zero = Enable automatic serial polling. Default determined by the GPIB configuration utility. Refer to the NI-488.2M user manual for more information about automatic serial polling.
`IbcCICPROT`	zero = Disable the CIC protocol. non-zero = Enable the CIC protocol. Default determined by the GPIB configuration utility. Refer to the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual for more information about the CIC protocol.
`IbcDMA`	Identical to `ibdma`. Default determined by the GPIB configuration utility.

(continues)

IBCONFIG Board Level/Device Level IBCONFIG (Continued)

Table 1-5. ibconfig Board Configuration Parameter Options (Continued)

Options (Constants)	Legal Values
IbcEndBitIsNormal	zero = Do not set the END bit of ibsta when an EOS match occurs during a read. non-zero = Set the END bit of ibsta when an EOS match occurs during a read. Default: non-zero.
IbcEOSchar	Any 8-bit value. This byte becomes the new EOS character. Default determined by the GPIB configuration utility.
IbcEOScmp	zero = Use 7 bits for the EOS character comparison. non-zero = Use 8 bits for the EOS character comparison. Default determined by the GPIB configuration utility.
IbcEOSrd	zero = Ignore EOS character during read operations. non-zero = Terminate reads when the EOS character is read. Default determined by the GPIB configuration utility.
IbcEOSwrt	zero = Do not assert EOI with the EOS character during write operations. non-zero = Assert EOI with the EOS character during write operations. Default determined by the GPIB configuration utility.
IbcEOT	Changes the data termination mode for write operations. Identical to ibeot. Default determined by the GPIB configuration utility.
IbcHSCableLength	0 = High-speed (HS488) data transfer is disabled. 1 to 15 = The number of meters of GPIB cable in your system. The NI-488.2M software uses this information to select the appropriate high-speed (HS488) data transfer mode. Default determined by the GPIB configuration utility. See the NI-488.2M user manual for information about high-speed (HS488) data transfer.
IbcIst	Changes the individual status (ist) bit of the board. Identical to ibist.

(continues)

IBCONFIG (Continued)

Table 1-5. ibconfig Board Configuration Parameter Options (Continued)

Options (Constants)	Legal Values
IbcPAD	Changes the primary address of the board. Identical to ibpad. Default determined by the GPIB configuration utility.
IbcPP2	zero = PP1 mode–remote parallel poll configuration. non-zero = PP2 mode–local parallel poll configuration. Default: zero. Refer to the NI-488.2M user manual for more information about parallel polling.
IbcPPC	Configures the board for parallel polls. Identical to board-level ibppc. Default: zero.
IbcPPollTime	0 = Use the standard duration (2 µs) when conducting a parallel poll. 1 to 17 = Use a variable length duration when conducting a parallel poll. The duration represented by 1 to 17 corresponds to the ibtmo values. Default: zero.
IbcReadAdjust	0 = No byte swapping. 1 = Swap pairs of bytes during a read. Default: zero.
IbcRsv	Changes the serial poll status byte of the board. Identical to ibrsv. Default: zero.
IbcSAD	Changes the secondary address of the board. Identical to ibsad. Default determined by the GPIB configuration utility.
IbcSC	Request or release system control. Identical to ibrsc. Default determined by the GPIB configuration utility.

(continues)

IBCONFIG (Continued)

Table 1-5. ibconfig Board Configuration Parameter Options (Continued)

Options (Constants)	Legal Values
IbcSendLLO	zero = Do not send LLO when putting a device online—ibfind or ibdev. non-zero = Send LLO when putting a device online—ibfind or ibdev. Default: zero.
IbcSRE	Assert the Remote Enable (REN) line. Identical to ibsre. Default: zero.
IbcTIMING	1 = Normal timing (T1 delay of 2 µs). 2 = High-speed timing (T1 delay of 500 ns). 3 = Very high-speed timing (T1 delay of 350 ns). Default determined by the GPIB configuration utility. The T1 delay is the GPIB Source Handshake timing.
IbcTMO	Changes the timeout period of the board. Identical to ibtmo. Default determined by the GPIB configuration utility.
IbcWriteAdjust	0 = No byte swapping. 1 = Swap pairs of bytes during a write. Default: zero.

Table 1-6 lists the options you can use with ibconfig when ud is a device descriptor or a device index. The following is an alphabetical list of the option constants.

- IbcEOSchar
- IbcEOScmp
- IbcEOSrd
- IbcEOSwrt
- IbcEOT
- IbcPAD
- IbcREADDR
- IbcReadAdjust
- IbcSAD
- IbcSPollTime
- IbcTMO
- IbcUnAddr
- IbcWriteAdjust

IBCONFIG Board Level/Device Level IBCONFIG
(Continued)

Table 1-6. ibconfig Device Configuration Parameter Options

Options (Constants)	Legal Values
IbcEOSchar	Any 8-bit value. This byte becomes the new EOS character. Default determined by the GPIB configuration utility.
IbcEOScmp	zero = Use seven bits for the EOS character comparison. non-zero = Use eight bits for the EOS character comparison. Default determined by the GPIB configuration utility.
IbcEOSrd	non-zero = Terminate reads when the EOS character is read. Default determined by the GPIB configuration utility.
IbcEOSwrt	zero = Do not send EOI with the EOS character during write operations. non-zero = Send EOI with the EOS character during writes. Default determined by the GPIB configuration utility.
IbcEOT	Changes the data termination method for writes. Identical to ibeot. Default determined by the GPIB configuration utility.
IbcPAD	Changes the primary address of the device. Identical to ibpad. Default determined by the GPIB configuration utility.
IbcREADDR	zero = No unnecessary readdressing is performed between device-level reads and writes. non-zero = Addressing is always performed before a device-level read or write. Default determined by the GPIB configuration utility.

(continues)

IBCONFIG Board Level/Device Level IBCONFIG
(Continued)

Table 1-6. ibconfig Device Configuration Parameter Options (Continued)

Options (Constants)	Legal Values
IbcReadAdjust	0 = No byte swapping. 1 = Swap pairs of bytes during a read. Default: zero.
IbcSAD	Changes the secondary address of the device. Identical to ibsad. Default determined by the GPIB configuration utility.
IbcSPollTime	0 to 17 = Sets the length of time the driver waits for a serial poll response byte when polling the given device. The length of time represented by 0 to 17 corresponds to the ibtmo values. Default: 11.
IbcTMO	Changes the device timeout period. Identical to ibtmo. Default determined by the GPIB configuration utility.
IbcUnAddr	zero = Do not send Untalk and Unlisten—UNT and UNL—at the end of device-level reads and writes. non-zero = Send UNT and UNL at the end of device-level reads and writes. Default: zero.
IbcWriteAdjust	0 = No byte swapping. 1 = Swap pairs of bytes during a write. Default: zero.

IBDEV — Device Level — IBDEV

Purpose

Open and initialize a device descriptor.

Format

C

```
int ibdev (int BdIndx, int pad, int sad, int tmo, int eot,
           int eos)
```

Visual Basic

```
CALL ibdev (BdIndx%, pad%, sad%, tmo%, eot%, eos%, ud%)
```

or

```
ud% = ildev (BdIndx%, pad%, sad%, tmo%, eot%, eos%)
```

Input

`BdIndx`	Index of the access board for the device
`pad`	The primary GPIB address of the device
`sad`	The secondary GPIB address of the device
`tmo`	The I/O timeout value
`eot`	EOI mode of the device
`eos`	EOS character and modes

Output

Function Return	The device descriptor or a -1

Description

`ibdev` acquires a device descriptor to use in subsequent device-level NI-488 functions. It opens and initializes a device descriptor, and configures it according to the input parameters.

For more details on the meaning and effect of each input parameter, see the corresponding NI-488 functions for `ibbna`, `ibpad`, `ibsad`, `ibtmo`, `ibeot`, and `ibeos`.

IBDEV Device Level IBDEV
(Continued)

If `ibdev` is unable to get a valid device descriptor, a -1 is returned; the ERR bit is set in `ibsta` and `iberr` contains EDVR.

Note: ***Unit descriptors are allocated on a per process basis, so it is not possible to share them between processes. If you pass a unit descriptor from one process to a second process, all GPIB calls using that descriptor in the second process will return EDVR.***

Possible Errors

EARG	`pad`, `sad`, `tmo`, `eot`, or `eos` is invalid. See `ibpad`, `ibsad`, `ibtmo`, `ibeot`, and `ibeos` for details on setting these parameters.
EDVR	Either no device descriptors are available or `BdIndx` refers to a GPIB board that is not installed.
ENEB	The interface board is not installed or is not properly configured.

IBDMA — Board Level — IBDMA

Purpose

Enable or disable DMA.

Format

C

```
int ibdma (int ud, int v)
```

Visual Basic

```
CALL ibdma (ud%, v%)
```

or

```
status% = ildma (ud%, v%)
```

Input

ud	A board descriptor
v	Enable or disable the use of DMA

Output

Function Return	The value of ibsta

Description

ibdma enables or disables DMA transfers for the board, according to v. If v is zero, then DMA is not used for GPIB I/O transfers. If v is non-zero, then DMA is used for GPIB I/O transfers.

Possible Errors

EARG	ud is valid but does not refer to an interface board.
ECAP	The interface board is not configured to use a DMA channel. Use the GPIB configuration utility to configure a DMA channel.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBEOS — Board Level/Device Level — IBEOS

Purpose

Configure the end-of-string (EOS) termination mode or character.

Format

C

```
int ibeos (int ud, int v)
```

Visual Basic

```
CALL ibeos (ud%, v%)
```

or

```
status% = ileos (ud%, v%)
```

Input

ud	A board or device descriptor
v	EOS mode and character information

Output

Function Return	The value of ibsta

Description

ibeos configures the EOS termination mode or EOS character for the board or device. The parameter v describes the new end-of-string (EOS) configuration to use. If v is zero, then the EOS configuration is disabled. Otherwise, the low byte is the EOS character and the upper byte contains flags which define the EOS mode.

Note: ***Defining an EOS byte does not cause the driver to automatically send that byte at the end of write I/O operations. Your application is responsible for placing the EOS byte at the end of the data strings that it defines.***

Table 1-7 describes the different EOS configurations and the corresponding values of v. If no error occurs during the call, then the value of the previous EOS setting is returned in iberr.

IBEOS Board Level/Device Level IBEOS
(Continued)

Table 1-7. EOS Configurations

Bit	Configuration	Value of v	
		High Byte	Low Byte
A	Terminate read when EOS is detected.	00000100	EOS character
B	Set EOI with EOS on write function.	00001000	EOS character
C	Compare all 8 bits of EOS byte rather than low 7 bits (all read and write functions).	00010000	EOS character

Configuration bits A and C determine how to terminate read I/O operations. If bit A is set and bit C is clear, then a read ends when a byte that matches the low seven bits of the EOS character is received. If bits A and C are both set, then a read ends when a byte that matches all eight bits of the EOS character is received.

Configuration bits B and C determine when a write I/O operation asserts the GPIB EOI line. If bit B is set and bit C is clear, then EOI is asserted when the written character matches the low seven bits of the EOS character. If bits B and C are both set, then EOI is asserted when the written character matches all eight bits of the EOS character.

For more information on the termination of I/O operations, refer to Chapter 7, *GPIB Programming Techniques*, in the NI-488.2M user manual.

Examples

```
ibeos (ud, 0x140A); /* Configure the software to end reads on
                       newline character (hex 0A) for the unit
                       descriptor, ud */

ibeos (ud, 0x180A); /* Configure the software to assert the GPIB
                       EOI line whenever the newline character
                       (hex 0A) is written out by the unit
                       descriptor, ud */
```

Possible Errors

EARG	The high byte of v contains invalid bits.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBEOT — Board Level/Device Level — IBEOT

Purpose

Enable or disable the automatic assertion of the GPIB EOI line at the end of write I/O operations.

Format

C

```
int ibeot (int ud, int v)
```

Visual Basic

```
CALL ibeot (ud%, v%)
```

or

```
status% = ileot (ud%, v%)
```

Input

ud	A board or device descriptor
v	Enables or disables the end of transmission assertion of EOI

Output

Function Return	The value of ibsta

Description

ibeot enables or disables the assertion of the EOI line at the end of write I/O operations for the board or device described by ud. If v is non-zero, then EOI is asserted when the last byte of a GPIB write is sent. If v is zero, then nothing occurs when the last byte is sent. If no error occurs during the call, then the previous value of EOT is returned in iberr.

For more information on the termination of I/O operations, refer to Chapter 7, *GPIB Programming Techniques*, in the NI-488.2M user manual.

Possible Errors

EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBFIND — Board Level/Device Level — IBFIND

Purpose

Open and initialize a board or a user-configured device descriptor.

Format

C

```
int ibfind (char *udname)
```

Visual Basic

```
CALL ibfind (udname$, ud%)
```

or

```
ud% = ilfind (udname$)
```

Input

udname	A user-configured device or board name

Output

Function Return	The board or device descriptor, or a -1

Description

ibfind is used to acquire a descriptor for a board or user-configured device; this board or device descriptor can be used in subsequent NI-488 functions.

ibfind performs the equivalent of an ibonl 1 to initialize the board or device descriptor. The unit descriptor returned by ibfind remains valid until the board or device is put offline using ibonl 0.

If ibfind is unable to get a valid descriptor, a -1 is returned; the ERR bit is set in ibsta and iberr contains EDVR.

Note: ***Unit descriptors are allocated on a per process basis, so it is not possible to share them between processes. If you pass a unit descriptor from one process to a second process, all GPIB calls using that descriptor in the second process will return EDVR.***

IBFIND — Board Level/Device Level — IBFIND
(Continued)

☞ **Note:** ***Using*** `ibfind` ***to obtain device descriptors is useful only for compatibility with existing applications. New applications should use*** `ibdev` ***instead of*** `ibfind`. `ibdev` ***is more flexible, easier to use, and frees the application from unnecessary device name requirements.***

Possible Errors

EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `udname` is not recognized as a board or device name or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.

IBGTS Board Level IBGTS

Purpose

Go from Active Controller to Standby.

Format

C

```
int ibgts (int ud, int v)
```

Visual Basic

```
CALL ibgts (ud%, v%)
```

or

```
status% = ilgts (ud%, v%)
```

Input

ud	Board descriptor
v	Determines whether to perform acceptor handshaking

Output

Function Return	The value of ibsta

Description

ibgts causes the GPIB board at ud to go to Standby Controller and the GPIB ATN line to be unasserted. If v is non-zero, acceptor handshaking or shadow handshaking is performed until END occurs or until ATN is reasserted by a subsequent ibcac call. With this option, the GPIB board can participate in data handshake as an acceptor without actually reading data. If END is detected, the interface board enters a Not Ready For Data (NRFD) handshake holdoff state which results in hold off of subsequent GPIB transfers. If v is 0, no acceptor handshaking or holdoff is performed.

Before performing an ibgts with shadow handshake, call the ibeos function to establish proper EOS modes.

For details on the IEEE-488.1 handshake protocol, refer to the ANSI/IEEE Standard 488.1-1987 document.

IBGTS Board Level IBGTS

(Continued)

Possible Errors

EADR	v is non-zero, and either ATN is low or the interface board is a Talker or a Listener.
EARG	ud is valid but does not refer to an interface board.
ECIC	The interface board is not Controller-In-Charge.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBIST — Board Level — IBIST

Purpose

Set or clear the board individual status bit for parallel polls.

Format

C

```
int ibist (int ud, int v)
```

Visual Basic

```
CALL ibist (ud%, v%)
```

or

```
status% = ilist (ud%, v%)
```

Input

ud	Board descriptor
v	Indicates whether to set or clear the ist bit

Output

Function Return	The value of ibsta

Description

ibist sets the interface board ist (individual status) bit according to v. If v is zero, the ist bit is cleared; if v is non-zero, the ist bit is set. The previous value of the ist bit is returned in iberr.

For more information on parallel polling, refer to the NI-488.2M user manual.

Possible Errors

EARG	ud is valid but does not refer to an interface board.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBLINES Board Level IBLINES

Purpose

Return the status of the eight GPIB control lines.

Format

C

```
int iblines (int ud, short *clines)
```

Visual Basic

```
CALL iblines (ud%, clines%)
```

or

```
status% = illines (ud%, clines%)
```

Input

ud	Board descriptor

Output

clines	Returns GPIB control line state information
Function Return	The value of ibsta

Description

iblines returns the state of the GPIB control lines in clines. The low-order byte (bits 0 through 7) of clines contains a mask indicating the capability of the GPIB interface board to sense the status of each GPIB control line. The upper byte (bits 8 through 15) contains the GPIB control line state information. The following is a pattern of each byte.

7	6	5	4	3	2	1	0
EOI	ATN	SRQ	REN	IFC	NRFD	NDAC	DAV

To determine if a GPIB control line is asserted, first check the appropriate bit in the lower byte to determine if the line can be monitored. If the line can be monitored (indicated by a 1 in the appropriate bit position), then check the corresponding bit in the upper byte. If the bit is set (1), the corresponding control line is asserted. If the bit is clear (0), the control line is unasserted.

IBLINES Board Level IBLINES
(Continued)

Example

```
short lines;
iblines (ud, &lines);
if (lines & ValidREN) {  /* check to see if REN is asserted */
   if (lines & BusREN) {
      printf ("REN is asserted");
   }
}
```

Possible Errors

EARG	ud is valid but does not refer to an interface board.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.

IBLN Board Level/Device Level IBLN

Purpose

Check for the presence of a device on the bus.

Format

C

```
int ibln (int ud, int pad, int sad, short *listen)
```

Visual Basic

```
CALL ibln (ud%, pad%, sad%, listen%)
```

or

```
status% = illn (ud%, pad%, sad%, listen%)
```

Input

ud	Board or device descriptor
pad	The primary GPIB address of the device
sad	The secondary GPIB address of the device

Output

listen	Indicates if a device is present or not
Function Return	The value of ibsta

Description

ibln determines whether there is a listening device at the GPIB address designated by the pad and sad parameters. If ud is a board descriptor, then the bus associated with that board is tested for Listeners. If ud is a device descriptor, then ibln uses the access board associated with that device to test for Listeners. If a Listener is detected, a non-zero value is returned in listen. If no Listener is found, zero is returned.

The pad parameter can be any valid primary address (a value between 0 and 30). The sad parameter can be any valid secondary address (a value between 96 to 126), or one of the constants NO_SAD or ALL_SAD. The constant NO_SAD designates that no secondary address is to be tested (only a primary address is tested). The constant ALL_SAD designates that all secondary addresses are to be tested.

IBLN Board Level/Device Level IBLN

(Continued)

Possible Errors

EARG	Either the `pad` or `sad` argument is invalid.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBLOC Board Level/Device Level IBLOC

Purpose

Go to Local.

Format

C

```
int ibloc (int ud)
```

Visual Basic

```
CALL ibloc (ud%)
```

or

```
status% = illoc (ud%)
```

Input

ud	Board or device descriptor

Output

Function Return	The value of ibsta

Description

Board Level

ibloc places the board in local mode if it is not in a lockout state. The board is in a lockout state if LOK does not appear in the status word ibsta. If the board is in a lockout state, the call has no effect.

The ibloc function is used to simulate a front panel RTL (Return to Local) switch if the computer is used as an instrument.

Device Level

Unless the REN (Remote Enable) line has been unasserted with the ibsre function, all device-level functions automatically place the specified device in remote program mode. ibloc is used to move devices temporarily from a remote program mode to a local mode until the next device function is executed on that device.

IBLOC Board Level/Device Level IBLOC

(Continued)

Possible Errors

EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBNOTIFY — Board Level/Device Level — IBNOTIFY

Purpose

Notify user of one or more GPIB events by invoking the user callback.

Format

C

```
int ibnotify (int ud, int mask, GpibNotifyCallback_t Callback,
    void * RefData)
```

Visual Basic

Not supported

Input

ud	Board or device descriptor
mask	Bit mask of GPIB events to notice
Callback	Pointer to the callback function (see prototype below)
RefData	User-defined reference data for the callback

Output

Function Return	The value of ibsta

Description

If mask is non-zero, ibnotify monitors the events specified by mask, and when one or more of the events is true, your Callback is invoked. The ibnotify mask bits are identical to the ibsta bits, and are defined in Table 1-8. For a board-level ibnotify call, all mask bits are valid except for ERR and RQS. For a device-level ibnotify call, the only valid mask bits are CMPL, TIMO, END, and RQS.

If TIMO is set in the notify mask, ibnotify calls the callback function when the timeout period has elapsed, if one or more of the other specified events have not already occurred. If TIMO is not set in the notify mask, then the callback is not called until one or more of the specified events occur.

IBNOTIFY (Continued)

Board Level/Device Level

IBNOTIFY

Table 1-8. Notify Mask Layout

Mnemonic	Bit Pos.	Hex Value	Description
TIMO	14	4000	Use the timeout period (see `ibtmo`) to limit the notify period
END	13	2000	END or EOS is detected
SRQI	12	1000	SRQ is asserted (board only)
RQS	11	800	Device requested service (device only)
CMPL	8	100	I/O completed (board only)
LOK	7	80	GPIB board is in Lockout State (board only)
REM	6	40	GPIB board is in Remote State (board only)
CIC	5	20	GPIB board is CIC (board only)
ATN	4	10	Attention is asserted (board only)
TACS	3	8	GPIB board is Talker (board only)
LACS	2	4	GPIB board is Listener (board only)
DTAS	1	2	GPIB board is in Device Trigger State (board only)
DCAS	0	1	GPIB board is in Device Clear State (board only)

Note: ***Notification is performed when the state of one or more of the mask bits is true, so if a request is made to be notified when CMPL is true, and CMPL is currently true, the*** `Callback` ***is invoked immediately.***

Note: ***For device-level usage, notification on RQS cannot be guaranteed to work if automatic serial polling is disabled. By default, automatic serial polling is enabled.***

A given `ud` can have only one outstanding `ibnotify` call at any one time. If a current `ibnotify` is in effect for `ud`, it is replaced by a subsequent `ibnotify` call. An outstanding `ibnotify` call for `ud` can be canceled by a subsequent `ibnotify` call for `ud` that has a `mask` of 0.

IBNOTIFY Board Level/Device Level IBNOTIFY (Continued)

If an ibnotify call is outstanding and one or more of the GPIB events it is waiting on become true, the Callback is invoked.

Callback Prototype

```
int __stdcall Callback
              (int ud, int ibsta, int iberr, long ibcntl,
               void *RefData)
```

Callback Parameters

ud	Board or device descriptor
ibsta	Value of ibsta
iberr	Value of iberr
ibcntl	Value of ibcntl
RefData	User-defined reference data for the callback

Callback Return Value

Bit mask of the GPIB events to notice next

The Callback function executes in a separate thread in your process. Therefore, it has access to any process global data, but no access to thread local data. If the Callback needs to access global data, you must protect that access using a synchronization primitive (for example, semaphore) because the Callback is running in a different thread context. Alternatively, the issue of data protection can be avoided entirely if the Callback simply posts a message to your application using the Windows PostMessage() function. The Callback function can call any of the NI-488 or NI-488.2 functions with the exception of ibnotify. When the Callback is invoked, the values of the GPIB global variables (ibsta, iberr, ibcntl) are undefined. The status variables passed to Callback should be examined, instead of the GPIB globals, to determine why the Callback was invoked. Notice that it is possible that the Callback may be invoked because of an error condition rather than because of the setting of one or more of the requested mask bits.

The return value of the Callback is interpreted as a mask value, which is used to automatically rearm the asynchronous event notification mechanism. If the return value is 0, it is not rearmed. If the return value is non-zero, the asynchronous event notification mechanism is rearmed with the return mask value. If the Callback rearm fails due to an error, the Callback is invoked with ibsta set to ERR, iberr set to EDVR, and ibcntl set to IBNOTIFY_REARM_FAILED, which is defined in decl-32.h.

IBNOTIFY Board Level/Device Level IBNOTIFY (Continued)

Like ibwait, ibstop, and ibonl, the invocation of the ibnotify Callback can cause the resynchronization of the handler after an asynchronous I/O operation has completed. In this case, the global variables passed into the Callback after I/O has completed contain the status of the I/O operation.

For more information of the usage of ibnotify and a detailed example, refer to the *Asynchronous Event Notification* section in Chapter 7, *GPIB Programming Techniques*, in the NI-488.2M user manual.

Possible Errors for ibnotify

EARG	A bit set in mask is invalid.
ECAP	ibnotify has been invoked from within an ibnotify Callback function, or the handler cannot perform notification on one or more of the specified mask bits.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed. ibcntl contains a system-dependent error code.
ENEB	The interface board is not installed or is not properly configured.

Possible Error for the Callback

EDVR	The Callback return failed to rearm the Callback.

IBONL — Board Level/Device Level — IBONL

Purpose

Place the device or interface board online or offline.

Format

C

```
int ibonl (int ud, int v)
```

Visual Basic

```
CALL ibonl (ud%, v%)
```

or

```
status% = ilonl (ud%, v%)
```

Input

ud	Board or device descriptor
v	Indicates whether the board or device is to be taken online or offline

Output

Function Return	The value of ibsta

Description

ibonl resets the board or device and places all its software configuration parameters in their pre-configured state. In addition, if v is zero, the device or interface board is taken offline. If v is non-zero, the device or interface board is left operational, or online.

If a device or an interface board is taken offline, the board or device descriptor (ud) is no longer valid. You must execute an ibdev or ibfind to access the board or device again.

Possible Errors

EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.

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IBPAD Board Level/Device Level IBPAD

Purpose

Change the primary address.

Format

C

```
int ibpad (int ud, int v)
```

Visual Basic

```
CALL ibpad (ud%, v%)
```

or

```
status% = ilpad (ud%, v%)
```

Input

ud	Board or device descriptor
v	GPIB primary address

Output

Function Return	The value of ibsta

Description

ibpad sets the primary GPIB address of the board or device to v, an integer ranging from 0 to 30. If no error occurs during the call, then iberr contains the previous GPIB primary address.

Possible Errors

EARG	v is not a valid primary GPIB address; it must be in the range 0 to 30.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBPCT — Device Level — IBPCT

Purpose

Pass control to another GPIB device with Controller capability.

Format

C

```
int ibpct (int ud)
```

Visual Basic

```
CALL ibpct (ud%)
```

or

```
status% = ilpct (ud%)
```

Input

ud	Device descriptor

Output

Function Return	The value of ibsta

Description

ibpct passes Controller-in-Charge status to the device indicated by ud. The access board automatically unasserts the ATN line and goes to Controller Idle State (CIDS). This function assumes that the device has Controller capability.

Possible Errors

EARG	ud is valid but does not refer to a device.
EBUS	No devices are connected to the GPIB.
ECIC	The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

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IBPPC — Board Level/Device Level — IBPPC

Purpose

Parallel poll configure.

Format

C

```
int ibppc (int ud, int v)
```

Visual Basic

```
CALL ibppc (ud%, v%)
```

or

```
status% = ilppc (ud%, v%)
```

Input

ud	Board or device descriptor
v	Parallel poll enable/disable value

Output

Function Return	The value of ibsta

Description

Device Level

If ud is a device descriptor, ibppc enables or disables the device from responding to parallel polls. The device is addressed and sent the appropriate parallel poll message—Parallel Poll Enable (PPE) or Disable (PPD). Valid parallel poll messages are 96 to 126 (hex 60 to hex 7E) or zero to send PPD.

Board Level

If ud is a board descriptor, ibppc performs a local parallel poll configuration using the parallel poll configuration value v. Valid parallel poll messages are 96 to 126 (hex 60 to hex 7E) or zero to send PPD. If no error occurs during the call, then iberr contains the previous value of the local parallel poll configuration.

For more information on parallel polling, refer to the NI-488.2M user manual.

IBPPC — Board Level/Device Level — IBPPC

(Continued)

Possible Errors

EARG	v does not contain a valid PPE or PPD message.
EBUS	Device level: No devices are connected to the GPIB.
ECAP	Board level: The board is not configured to perform local parallel poll configuration. (See `ibconfig`, option `IbcPP2`.)
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBRD Board Level/Device Level IBRD

Purpose

Read data from a device into a user buffer.

Format

C

```
int ibrd (int ud, void *rdbuf, long count)
```

Visual Basic

```
CALL ibrd (ud%, rdbuf$)
```

or

```
status% = ilrd (ud%, rdbuf$, count&)
```

Input

ud	Board or device descriptor
count	Number of bytes to be read from the GPIB

Output

rdbuf	Address of buffer into which data is read
Function Return	The value of ibsta

Description

Device Level

If ud is a device descriptor, ibrd addresses the GPIB, reads up to count bytes of data, and places the data into the buffer specified by rdbuf. The operation terminates normally when count bytes have been received or END is received. The operation terminates with an error if the transfer could not complete within the timeout period. The actual number of bytes transferred is returned in the global variable ibcntl.

IBRD Board Level/Device Level IBRD
(Continued)

Board Level

If ud is a board descriptor, ibrd reads up to count bytes of data and places the data into the buffer specified by rdbuf. A board-level ibrd assumes that the GPIB is already properly addressed. The operation terminates normally when count bytes have been received or END is received. The operation terminates with an error if the transfer could not complete within the timeout period or, if the board is not CIC, the CIC sends a Device Clear on the GPIB. The actual number of bytes transferred is returned in the global variable ibcntl.

Possible Errors

EABO	Either count bytes or END was not received within the timeout period or a Device Clear message was received after the read operation began.
EADR	Board level: The GPIB is not correctly addressed; use ibcmd to address the GPIB. Device level: A conflict exists between the device GPIB address and the GPIB address of the device access board. Use ibpad and ibsad.
EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBRDA — Board Level/Device Level — IBRDA

Purpose

Read data asynchronously from a device into a user buffer.

Format

C

```
int ibrda (int ud, int *rdbuf, long count)
```

Visual Basic

```
CALL ibrda (ud%, rdbuf$)
```

or

```
status% = ilrda (ud%, rdbuf$, count&)
```

Input

ud	Board or device descriptor
count	Number of bytes to be read from the GPIB

Output

rdbuf	Address of buffer into which data is read
Function Return	The value of ibsta

Description

Device Level

If ud is a device descriptor, ibrda addresses the GPIB, begins an asynchronous read of up to count bytes of data from a GPIB device, and places the data into the buffer specified by rdbuf. The operation terminates normally when count bytes have been received or END is received. The actual number of bytes transferred is returned in the global variable ibcntl.

Board Level

If ud is a board descriptor, ibrda reads up to count bytes of data from a GPIB device and places the data into the buffer specified by rdbuf. A board-level ibrda assumes that the GPIB is already properly addressed. The operation terminates normally when count bytes have been received or END is received. The operation terminates with an error if

the board is not the CIC, and the CIC sends a Device Clear on the GPIB. The actual number of bytes transferred is returned in the global variable `ibcntl`.

Board and Device Level

The asynchronous I/O calls (`ibcmda`, `ibrda`, `ibwrta`) are designed so that applications can perform other non-GPIB operations while the I/O is in progress. Once the asynchronous I/O has begun, further GPIB calls are strictly limited. Any calls that would interfere with the I/O in progress are not allowed; the driver returns EOIP in this case.

Once the I/O is complete, the application must *resynchronize* with the NI-488.2M driver. Resynchronization is accomplished by using one of the following functions:

`ibnotify`	If the `ibsta` value passed to the `ibnotify` callback contains CMPL, then the driver and application are resynchronized.
`ibwait`	If the returned `ibsta` contains CMPL, then the driver and application are resynchronized.
`ibstop`	The I/O is canceled; the driver and application are resynchronized.
`ibonl`	The I/O is canceled and the interface is reset; the driver and application are resynchronized.

Possible Errors

EABO	Board level: a Device Clear message was received from the CIC.
EADR	Board level: The GPIB is not correctly addressed; use `ibcmd` to address the GPIB. Device level: A conflict exists between the device GPIB address and the GPIB address of the device access board. Use `ibpad` and `ibsad`.
EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

Purpose

Read data from a device into a file.

Format

C

```
int ibrdf (int ud, char *flname)
```

Visual Basic

```
CALL ibrdf (ud%, flname$)
```

or

```
status% = ilrdf (ud%, flname$)
```

Input

`ud`	Board or device descriptor
`flname`	Name of file into which data is read

Output

Function Return	The value of `ibsta`

Description

Device Level

If `ud` is a device descriptor, `ibrdf` addresses the GPIB, reads data from a GPIB device, and places the data into the file specified by `flname`. The operation terminates normally when END is received. The operation terminates with an error if the transfer could not complete within the timeout period. The actual number of bytes transferred is returned in the global variable `ibcntl`.

Board Level

If `ud` is a board descriptor, `ibrdf` reads data from a GPIB device and places the data into the file specified by `flname`. A board-level `ibrdf` assumes that the GPIB is already properly addressed. The operation terminates normally when END is received. The operation terminates with an error if the transfer could not complete within the timeout

IBRDF Board Level/Device Level IBRDF
(Continued)

period or, if the board is not CIC, the CIC sends a Device Clear on the GPIB. The actual number of bytes transferred is returned in the global variable `ibcntl`.

Possible Errors

EABO	END was not received within the timeout period, or `ud` is a board descriptor and Device Clear was received after the read operation began.
EADR	Board level: The GPIB is not correctly addressed; use `ibcmd` to address the GPIB. Device level: A conflict exists between the device GPIB address and the GPIB address of the device access board. Use `ibpad` and `ibsad`.
EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
EFSO	`ibrdf` could not access `flname`.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBRPP Board Level/Device Level IBRPP

Purpose

Conduct a parallel poll.

Format

C

```
int ibrpp (int ud, char *ppr)
```

Visual Basic

```
CALL ibrpp (ud%, ppr%)
```

or

```
status% = ilrpp (ud%, ppr%)
```

Input

ud	Board or device descriptor

Output

ppr	Parallel poll response byte
Function Return	The value of ibsta

Description

ibrpp parallel polls all the devices on the GPIB. The result of this poll is returned in ppr.

For more information on parallel polling, refer to the NI-488.2M user manual.

Possible Errors

EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBRSC Board Level IBRSC

Purpose

Request or release system control.

Format

C

```
int ibrsc (int ud, int v)
```

Visual Basic

```
CALL ibrsc (ud%, v%)
```

or

```
status% = ilrsc (ud%, v%)
```

Input

ud	Board descriptor
v	Determines if system control is to be requested or released

Output

Function Return	The value of ibsta

Description

ibrsc requests or releases the capability to send Interface Clear (IFC) and Remote Enable (REN) messages to devices. If v is zero, the board releases system control, and functions requiring System Controller capability are not allowed. If v is non-zero, functions requiring System Controller capability are subsequently allowed. If no error occurs during the call, then iberr contains the previous System Controller state of the board.

Possible Errors

EARG	ud is a valid descriptor but does not refer to a board.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

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Purpose

Conduct a serial poll.

Format

C

```
int ibrsp (int ud, char *spr)
```

Visual Basic

```
CALL ibrsp (ud%, spr%)
```

or

```
status% = ilrsp (ud%, spr%)
```

Input

ud	Device descriptor

Output

spr	Serial poll response byte
Function Return	The value of ibsta

Description

The ibrsp function is used to serial poll the device ud. The serial poll response byte is returned in spr. If bit 6 (hex 40) of the response is set, the device is requesting service. When the automatic serial polling feature is enabled, the device might have already been polled. In this case, ibrsp returns the previously acquired status byte.

For more information on serial polling, refer to the NI-488.2M user manual.

Possible Errors

EABO	The serial poll response could not be read within the serial poll timeout period.
EARG	ud is a valid descriptor but does not refer to a device.
EBUS	No devices are connected to the GPIB.
ECIC	The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.

IBRSP Device Level IBRSP
(Continued)

ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ESTB	Autopolling is enabled and the serial poll queue of the device has overflowed. Call `ibrsp` more often to keep the queue from overflowing.

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IBRSV Board Level IBRSV

Purpose

Request service and change the serial poll status byte.

Format

C

```
int ibrsv (int ud, int v)
```

Visual Basic

```
CALL ibrsv (ud%, v%)
```

or

```
status% = ilrsv (ud%, v%)
```

Input

ud	Board descriptor
v	Serial poll status byte

Output

Function Return	The value of ibsta

Description

ibrsv is used to request service from the Controller and to provide the Controller with an application-dependent status byte when the Controller serial polls the GPIB board.

The value v is the status byte that the GPIB board returns when serial polled by the Controller-In-Charge. If bit 6 (hex 40) is set in v, the GPIB board requests service from the Controller by asserting the GPIB SRQ line. When ibrsv is called and an error does not occur, the previous status byte is returned in iberr.

Possible Errors

EARG	ud is a valid descriptor but does not refer to a board.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBSAD Board Level/Device Level IBSAD

Purpose

Change or disable the secondary address.

Format

C

```
int ibsad (int ud, int v)
```

Visual Basic

```
CALL ibsad (ud%, v%)
```

or

```
status% = ilsad (ud%, v%)
```

Input

ud	Board or device descriptor
v	GPIB secondary address

Output

Function Return	The value of ibsta

Description

ibsad changes the secondary GPIB address of the given board or device to v, an integer in the range 96 to 126 (hex 60 to hex 7E) or zero. If v is zero, secondary addressing is disabled. If no error occurs during the call, then the previous value of the GPIB secondary address is returned in iberr.

Possible Errors

EARG	v is non-zero and outside the legal range 96 to 126.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

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IBSIC — Board Level — IBSIC

Purpose

Assert interface clear.

Format

C

```
int ibsic (int ud)
```

Visual Basic

```
CALL ibsic (ud%)
```

or

```
status% = ilsic (ud%)
```

Input

ud	Board descriptor

Output

Function Return	The value of ibsta

Description

ibsic asserts the GPIB interfaces clear (IFC) line for at least 100 µs if the GPIB board is System Controller. This initializes the GPIB and makes the interface board CIC and Active Controller with ATN asserted.

The IFC signal resets only the GPIB interface functions of bus devices and not the internal device functions. Consult your device documentation to determine how to reset the internal functions of your device.

Possible Errors

EARG	ud is a valid descriptor but does not refer to a board.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ESAC	The board does not have System Controller capability.

IBSRE Board Level IBSRE

Purpose

Set or clear the Remote Enable line.

Format

C

```
int ibsre (int ud, int v)
```

Visual Basic

```
CALL ibsre (ud%, v%)
```

or

```
status% = ilsre (ud%, v%)
```

Input

ud	Board descriptor
v	Indicates whether to set or clear the REN line

Output

Function Return	The value of ibsta

Description

If v is non-zero, the GPIB Remote Enable (REN) line is asserted. If v is zero, REN is unasserted. The previous value of REN is returned in iberr.

REN is used by devices to choose between local and remote modes of operation. A device should not actually enter remote mode until it receives its listen address.

Possible Errors

EARG	ud is a valid descriptor but does not refer to a board.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ESAC	The board does not have System Controller capability.

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IBSTOP — Board Level/Device Level — IBSTOP

Purpose

Abort asynchronous I/O operation.

Format

C

```
int ibstop (int ud)
```

Visual Basic

```
CALL ibstop (ud%)
```

or

```
status% = ilstop (ud%)
```

Input

ud	Board or device descriptor

Output

Function Return	The value of ibsta

Description

The ibstop function aborts any asynchronous read, write, or command operation that is in progress and resynchronizes the application with the driver. If asynchronous I/O is in progress, the error bit is set in the status word, ibsta, and EABO is returned, indicating that the I/O was successfully stopped.

Possible Errors

EABO	Asynchronous I/O was successfully stopped.
EBUS	Device level: No devices are connected to the GPIB.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.

IBTMO — Board Level/Device Level — IBTMO

Purpose

Change or disable the timeout period.

Format

C

```
int ibtmo (int ud, int v)
```

Visual Basic

```
CALL ibtmo (ud%, v%)
```

or

```
status% = iltmo (ud%, v%)
```

Input

ud	Board or device descriptor
v	Timeout duration code

Output

Function Return	The value of ibsta

Description

ibtmo sets the timeout period of the board or device to v. The timeout period is used to select the maximum duration allowed for a synchronous I/O operation (for example, ibrd and ibwrt) or for an ibwait or ibnotify operation with TIMO in the wait mask. If the operation does not complete before the timeout period elapses, then the operation is aborted and TIMO is returned in ibsta. See Table 1-9 for a list of valid timeout values. These timeout values represent the minimum timeout period. The actual period may be longer.

IBTMO Board Level/Device Level IBTMO
(Continued)

Table 1-9. Timeout Code Values

Constant	Value of v	Minimum Timeout
TNONE	0	disabled - no timeout
T10us	1	10 µs
T30us	2	30 µs
T100us	3	100 µs
T300us	4	300 µs
T1ms	5	1 ms
T3ms	6	3 ms
T10ms	7	10 ms
T30ms	8	30 ms
T100ms	9	100 ms
T300ms	10	300 ms
T1s	11	1 s
T3s	12	3 s
T10s	13	10 s
T30s	14	30 s
T100s	15	100 s
T300s	16	300 s
T1000s	17	1000 s

Possible Errors

EARG v is invalid.
EDVR Either ud is invalid or the NI-488.2M driver is not installed.
ENEB The interface board is not installed or is not properly configured.

IBTRG Device Level IBTRG

Purpose

Trigger selected device.

Format

C

```
int ibtrg (int ud)
```

Visual Basic

```
CALL ibtrg (ud%)
```

or

```
status% = iltrg (ud%)
```

Input

ud	Device descriptor

Output

Function Return	The value of ibsta

Description

ibtrg sends the Group Execute Trigger (GET) message to the device described by ud.

Possible Errors

EARG	ud is a valid descriptor but does not refer to a device.
EBUS	No devices are connected to the GPIB.
ECIC	The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either ud is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

IBWAIT — Board Level/Device Level — IBWAIT

Purpose

Wait for GPIB events.

Format

C

```
int ibwait (int ud, int mask)
```

Visual Basic

```
CALL ibwait (ud%, mask%)
```

or

```
status% = ilwait (ud%, mask%)
```

Input

ud	Board or device descriptor
mask	Bit mask of GPIB events to wait for

Output

Function Return	The value of ibsta

Description

ibwait monitors the events specified by mask and delays processing until one or more of the events occurs. If the wait mask is zero, ibwait returns immediately with the updated ibsta status word. If TIMO is set in the wait mask, ibwait returns when the timeout period has elapsed, if one or more of the other specified events have not already occurred. If TIMO is not set in the wait mask, then the function waits indefinitely for one or more of the specified events to occur. The existing ibwait mask bits are identical to the ibsta bits and they are described in Table 1-10. If ud is a device descriptor, the only valid wait mask bits are TIMO, END, RQS, and CMPL. If ud is a board descriptor, all wait mask bits are valid except for RQS. You can configure the timeout period using the ibtmo function.

IBWAIT — Board Level/Device Level — IBWAIT
(Continued)

Table 1-10. Wait Mask Layout

Mnemonic	Bit Pos.	Hex Value	Description
TIMO	14	4000	Use the timeout period (see `ibtmo`) to limit the notify period
END	13	2000	END or EOS is detected
SRQI	12	1000	SRQ is asserted (board only)
RQS	11	800	Device requested service (device only)
CMPL	8	100	I/O completed (board only)
LOK	7	80	GPIB board is in Lockout State (board only)
REM	6	40	GPIB board is in Remote State (board only)
CIC	5	20	GPIB board is CIC (board only)
ATN	4	10	Attention is asserted (board only)
TACS	3	8	GPIB board is Talker (board only)
LACS	2	4	GPIB board is Listener (board only)
DTAS	1	2	GPIB board is in Device Trigger State (board only)
DCAS	0	1	GPIB board is in Device Clear State (board only)

Possible Errors

EARG The bit set in `mask` is invalid.

EBUS Device level: No devices are connected to the GPIB.

ECIC Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.

EDVR Either `ud` is invalid or the NI-488.2M driver is not installed.

ENEB The interface board is not installed or is not properly configured.

ESRQ Device level: If RQS is set in the wait mask, then ESRQ indicates that the *Stuck SRQ* condition exists. For more information on serial polling, refer to the NI-488.2M user manual.

IBWRT — Board Level/Device Level — IBWRT

Purpose

Write data to a device from a user buffer.

Format

C

```
int ibwrt (int ud, void *wrtbuf, long count)
```

Visual Basic

```
CALL ibwrt (ud%, wrtbuf$)
```

or

```
status% = ilwrt (ud%, wrtbuf$, count&)
```

Input

ud	Board or device descriptor
wrtbuf	Address of the buffer containing the bytes to write
count	Number of bytes to be written

Output

Function Return	The value of ibsta

Description

Device Level

If ud is a device descriptor, ibwrt addresses the GPIB and writes count bytes from the memory location specified by wrtbuf to a GPIB device. The operation terminates normally when count bytes have been sent. The operation terminates with an error if count bytes could not be sent within the timeout period. The actual number of bytes transferred is returned in the global variable ibcntl.

Board Level

If ud is a board descriptor, ibwrt writes count bytes of data from the buffer specified by wrtbuf to a GPIB device; a board-level ibwrt assumes that the GPIB is already properly addressed. The operation terminates normally when count bytes have been sent. The operation terminates with an error if count bytes could not be sent within the

timeout period or, if the board is not CIC, the CIC sends Device Clear on the GPIB. The actual number of bytes transferred is returned in the global variable `ibcntl`.

Possible Errors

EABO	Either `count` bytes were not sent within the timeout period, or a Device Clear message was received after the write operation began.
EADR	Board level: The GPIB is not correctly addressed; use `ibcmd` to address the GPIB. Device level: A conflict exists between the device GPIB address and the GPIB address of the device access board. Use `ibpad` and `ibsad`.
EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
ENOL	No Listeners were detected on the bus.
EOIP	Asynchronous I/O is in progress.

IBWRTA Board Level/Device Level IBWRTA

Purpose

Write data asynchronously to a device from a user buffer.

Format

C

```
int ibwrta (int ud, int *wrtbuf, long count)
```

Visual Basic

```
CALL ibwrta (ud%, wrtbuf$)
    or
status% = ilwrta (ud%, wrtbuf$, count&)
```

Input

ud	Board or device descriptor
wrtbuf	Address of the buffer containing the bytes to write
count	Number of bytes to be written

Output

Function Return	The value of ibsta

Description

Device Level

If ud is a device descriptor, ibwrta addresses the GPIB properly and writes count bytes from wrtbuf to a GPIB device. The operation terminates normally when count bytes have been sent. The actual number of bytes transferred is returned in the global variable ibcntl.

Board Level

If ud is a board descriptor, ibwrta begins an asynchronous write of count bytes of data from wrtbuf to a GPIB device. A board-level ibwrta assumes that the GPIB is already properly addressed. The operation terminates normally when count bytes have been sent. The operation terminates with an error if the board is not the CIC, and the CIC sends a Device Clear on the GPIB. The actual number of bytes transferred is returned in the global variable ibcntl.

Board and Device Level

The asynchronous I/O calls (`ibcmda`, `ibrda`, `ibwrta`) are designed so that applications can perform other non-GPIB operations with the I/O in progress. Once the asynchronous I/O begins, further GPIB calls are strictly limited. Any calls that would interfere with the I/O in progress are not allowed; the driver returns EOIP in this case.

Once the I/O is complete, the application must *resynchronize* with the NI-488.2M driver. Resynchronization is accomplished by using one of the following functions:

`ibnotify`	If the `ibsta` value passed to the `ibnotify` callback contains CMPL, then the driver and application are resynchronized.
`ibwait`	If the returned `ibsta` contains CMPL, then the driver and application are resynchronized.
`ibstop`	The I/O is canceled; the driver and application are resynchronized.
`ibonl`	The I/O is canceled and the interface is reset; the driver and application are resynchronized.

Possible Errors

EABO	Board level: A Device Clear message was received from the CIC.
EADR	Board level: The GPIB is not correctly addressed; use `ibcmd` to address the GPIB. Device level: A conflict exists between the device GPIB address and the GPIB address of the device access board. Use `ibpad` and `ibsad`.
EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
ENOL	No Listeners were detected on the bus.
EOIP	Asynchronous I/O is in progress.

IBWRTF Board Level/Device Level IBWRTF

Purpose

Write data to a device from a file.

Format

C

```
int ibwrtf (int ud, char *flname)
```

Visual Basic

```
CALL ibwrtf (ud%, flname$)
```

or

```
status% = ilwrtf (ud%, flname$)
```

Input

ud	Board or device descriptor
flname	Name of file containing the data to be written

Output

Function Return	The value of ibsta

Description

Device Level

If ud is a device descriptor, ibwrtf addresses the GPIB and writes all of the bytes from the file flname to a GPIB device. The operation terminates normally when all of the bytes have been sent. The operation terminates with an error if all of the bytes could not be sent within the timeout period. The actual number of bytes transferred is returned in the global variable ibcntl.

Board Level

If ud is a board descriptor, ibwrtf writes all of the bytes of data from the file flname to a GPIB device. A board-level ibwrtf assumes that the GPIB is already properly addressed. The operation terminates normally when all of the bytes have been sent. The operation terminates with an error if all of the bytes could not be sent within the timeout period, or if the board is not CIC, the CIC sends a Device Clear on the GPIB. The actual number of bytes transferred is returned in the global variable ibcntl.

(Continued)

Possible Errors

EABO	Either the file could not be transferred within the timeout period, or a Device Clear message was received after the write operation began.
EADR	Board level: The GPIB is not correctly addressed; use `ibcmd` to address the GPIB. Device level: A conflict exists between the device GPIB address and the GPIB address of the device access board. Use `ibpad` and `ibsad`.
EBUS	Device level: No devices are connected to the GPIB.
ECIC	Device level: The access board is not CIC. See the *Device-Level Calls and Bus Management* section in the NI-488.2M user manual.
EDVR	Either `ud` is invalid or the NI-488.2M driver is not installed.
EFSO	`ibwrtf` could not access `flname`.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

Chapter 2

NI-488.2 Routines

This chapter lists the NI-488.2 routines and describes the purpose, format, input and output parameters, and possible errors for each routine.

For general programming information, refer to the NI-488.2M user manual. The user manual explains how to develop and debug your program. It also describes the example programs included with your NI-488.2M software.

Routine Names

The routines in this chapter are listed alphabetically.

Purpose

Each routine description includes a brief statement of the purpose of the routine.

Format

The format section describes the format of each routine in the following languages: Microsoft Visual C/C++ (version 2.0 or higher), Borland C/C++ (version 4.0 or higher), and Microsoft Visual Basic (version 4.0 or higher)

Input and Output

The input and output parameters for each routine are also listed. Most of the NI-488.2 routines have an input parameter which is either a single address or a list of addresses. The address parameter is a 16-bit integer that has two components: the low byte is a valid primary address (0 to 30), and the high byte is a valid secondary address (`NO_SAD(0)` or 96 to 126). A list of addresses is an array of single addresses. You must mark the end of the list with the constant `NOADDR`. An empty address list is either an array with only the `NOADDR` constant in it, or a `NULL` pointer.

The C language interface header file includes the definition of a type (`typedef`) called `Addr4882_t`. Use the `Addr4882_t` type when declaring addresses or address lists.

Description

The description section gives details about the purpose and effect of each routine.

Examples

For detailed and complete examples, refer to the example programs that are included with your NI-488.2M software. The example programs are described in Chapter 2 of the NI-488.2M user manual.

Possible Errors

Each routine description includes a list of errors that could occur when it is invoked.

List of NI-488.2 Routines

The following table contains an alphabetical list of the NI-488.2 routines.

Table 2-1. NI-488.2 Routines

Routine	Purpose
AllSpoll	Serial poll all devices
DevClear	Clear a single device
DevClearList	Clear multiple devices
EnableLocal	Enable operations from the front panel of devices (leave remote programming mode)
EnableRemote	Enable remote GPIB programming for devices
FindLstn	Find listening devices on GPIB
FindRQS	Determines which device is requesting service
PassControl	Pass control to another device with Controller capability
PPoll	Perform a parallel poll on the GPIB
PPollConfig	Configure a device for parallel polls
PPollUnconfig	Unconfigure devices for parallel polls
RcvRespMsg	Read data bytes from a device that is already addressed to talk
ReadStatusByte	Serial poll a single device
Receive	Read data bytes from a device
ReceiveSetup	Address a device to be a Talker and the interface board to be a Listener in preparation for RcvRespMsg
ResetSys	Reset and initialize IEEE 488.2-compliant devices
Send	Send data bytes to a device
SendCmds	Send GPIB command bytes

(continues)

Table 2-1. NI-488.2 Routines (Continued)

Routine	Purpose
SendDataBytes	Send data bytes to devices that are already addressed to listen
SendIFC	Reset the GPIB by sending interface clear
SendList	Send data bytes to multiple GPIB devices
SendLLO	Send the Local Lockout (LLO) message to all devices
SendSetup	Setup devices to receive data in preparation for SendDataBytes
SetRWLS	Place devices in remote with lockout state
TestSRQ	Determine the current state of the GPIB Service Request (SRQ) line
TestSys	Cause the IEEE 488.2-compliant devices to conduct self tests
Trigger	Trigger a device
TriggerList	Trigger multiple devices
WaitSRQ	Wait until a device asserts the GPIB Service Request (SRQ) line

AllSpoll AllSpoll

Purpose

Serial poll all devices.

Format

C

```
void AllSpoll (int boardID, Addr4882_t *addrlist,
               short *resultlist)
```

Visual Basic

```
CALL AllSpoll (boardID%, addrlist%(), resultlist%())
```

Input

boardID	The interface board number
addrlist	A list of device addresses that is terminated by NOADDR

Output

resultlist	A list of serial poll response bytes corresponding to device addresses in addrlist

Description

AllSpoll serial polls all of the devices described by addrlist. It stores the poll responses in resultlist and the number of responses in ibcntl.

Possible Errors

EABO	One of the devices timed out instead of responding to the serial poll; ibcntl contains the index of the timed-out device.
EARG	An invalid address appears in addrlist; ibcntl is the index of the invalid address in the addrlist array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

DevClear DevClear

Purpose

Clear a single device.

Format

C

```
void DevClear (int boardID, Addr4882_t address)
```

Visual Basic

```
CALL DevClear (boardID%, address%)
```

Input

`boardID`	The interface board number
`address`	Address of the device you want to clear

Description

`DevClear` sends the Selected Device Clear (SDC) GPIB message to the device described by `address`. If `address` is the constant `NOADDR`, then the Universal Device Clear (DCL) message is sent to all devices.

Possible Errors

EARG	The `address` parameter is invalid.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

DevClearList

DevClearList

Purpose

Clear multiple devices.

Format

C

```
void DevClearList (int boardID, Addr4882_t *addrlist)
```

Visual Basic

```
CALL DevClearList (boardID%, addrlist%())
```

Input

`boardID`	The interface board number
`addrlist`	A list of device addresses terminated by `NOADDR` that you want to clear

Description

`DevClearList` sends the Selected Device Clear (SDC) GPIB message to all the device addresses described by `addrlist`. If `addrlist` contains only the constant `NOADDR`, then the Universal Device Clear (DCL) message is sent to all the devices on the bus.

Possible Errors

EARG	An invalid address appears in `addrlist`; `ibcntl` is the index of the invalid address in the `addrlist` array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

EnableLocal EnableLocal

Purpose

Enable operations from the front panel of devices (leave remote programming mode).

Format

C

```
void EnableLocal (int boardID, Addr4882_t *addrlist)
```

Visual Basic

```
CALL EnableLocal (boardID%, addrlist%())
```

Input

`boardID`	The interface board number
`addrlist`	A list of device addresses that is terminated by `NOADDR`

Description

`EnableLocal` sends the Go To Local (GTL) GPIB message to all the devices described by `addrlist`. This places the devices into local mode. If `addrlist` contains only the constant `NOADDR`, then the Remote Enable (REN) GPIB line is unasserted.

Possible Errors

EARG	An invalid address appears in `addrlist`; `ibcntl` is the index of the invalid address in the `addrlist` array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ESAC	The interface board is not configured as System Controller.

EnableRemote EnableRemote

Purpose

Enable remote GPIB programming for devices.

Format

C

```
void EnableRemote (int boardID, Addr4882_t *addrlist)
```

Visual Basic

```
CALL EnableRemote (boardID%, addrlist%())
```

Input

`boardID`	The interface board number
`addrlist`	A list of device addresses that is terminated by `NOADDR`

Description

`EnableRemote` asserts the Remote Enable (REN) GPIB line. All devices described by `addrlist` are put into a listen-active state.

Possible Errors

EARG	An invalid address appears in `addrlist`; `ibcntl` is the index of the invalid address in the `addrlist` array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ESAC	The interface board is not configured as System Controller.

FindLstn FindLstn

Purpose

Find listening devices on the GPIB.

Format

C

```
void FindLstn (int boardID, Addr4882_t *padlist,
               short *resultlist, int limit)
```

Visual Basic

```
CALL FindLstn (boardID%, padlist%(), resultlist%(), limit%)
```

Input

boardID	The interface board number
padlist	A list of primary addresses that is terminated by NOADDR
limit	Total number of entries that can be placed in resultlist

Output

resultlist	Addresses of all listening devices found by FindLstn are placed in this array

Description

FindLstn tests all of the primary addresses in padlist as follows: If a device is present at a primary address given in padlist, then the primary address is stored in resultlist. Otherwise, all secondary addresses of the primary address are tested, and the addresses of any devices found are stored in resultlist. No more than limit addresses are stored in resultlist. ibcntl contains the actual number of addresses stored in resultlist.

Possible Errors

EARG	An invalid primary address appears in padlist; ibcntl is the index of the invalid address in the padlist array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.

FindLstn (Continued)

FindLstn

EOIP	Asynchronous I/O is in progress.
ETAB	The number of devices found on the GPIB exceed `limit`.

FindRQS FindRQS

Purpose

Determine which device is requesting service.

Format

C

```
void FindRQS (int boardID, Addr4882_t *addrlist, short *result)
```

Visual Basic

```
CALL FindRQS (boardID%, addrlist%(), result%)
```

Input

boardID	The interface board number
addrlist	List of device addresses that is terminated by NOADDR

Output

result	Serial poll response byte of the device that is requesting service

Description

FindRQS serial polls the devices described by addrlist, in order, until it finds a device which is requesting service. The serial poll response byte is then placed in result. ibcntl contains the index of the device requesting service in addrlist. If none of the devices are requesting service, then the index corresponding to NOADDR in addrlist is returned in ibcntl and ETAB is returned in iberr.

Possible Errors

EARG	An invalid address appears in addrlist; ibcntl is the index of the invalid address in the addrlist array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ETAB	None of the devices in addrlist are requesting service or addrlist contains only NOADDR. ibcntl contains the index of NOADDR in addrlist.

PassControl PassControl

Purpose

Pass control to another device with Controller capability.

Format

C

```
void PassControl (int boardID, Addr4882_t address)
```

Visual Basic

```
CALL PassControl (boardID%, address%)
```

Input

`boardID`	The interface board number
`address`	Address of the device to which you want to pass control

Description

`PassControl` sends the Take Control (TCT) GPIB message to the device described by `address`. The device becomes Controller-In-Charge and the interface board is no longer CIC.

Possible Errors

EARG	The `address` parameter is invalid. It must be a valid primary/secondary address pair. It cannot be the constant `NOADDR`.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

PPoll

Purpose

Perform a parallel poll on the GPIB.

Format

C

```
void PPoll (int boardID, short *result)
```

Visual Basic

```
CALL PPoll (boardID%, result%)
```

Input

`boardID`	The interface board number

Output

`result`	The parallel poll result

Description

`PPoll` conducts a parallel poll and the result is placed in `result`. Each of the eight bits of `result` represents the status information for each device configured for a parallel poll. The interpretation of the status information is based on the latest parallel poll configuration command sent to each device (see `PPollConfig` and `PPollUnconfig`). The Controller can use parallel polling to obtain one-bit, device-dependent status messages from up to eight devices simultaneously.

For more information on parallel polling, refer to the NI-488.2M user manual.

Possible Errors

EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

PPollConfig PPollConfig

Purpose

Configure a device to respond to parallel polls.

Format

C

```
void PPollConfig (int boardID, Addr4882_t address, int dataline,
                  int lineSense)
```

Visual Basic

```
CALL PPollConfig (boardID%, address%, dataline%, lineSense%)
```

Input

`boardID`	The interface board number
`address`	Address of the device to be configured
`dataline`	Data line (a value in the range of 1 to 8) on which the device responds to parallel polls
`lineSense`	Sense (either 0 or 1) of the parallel poll response

Description

`PPollConfig` configures the device described by `address` to respond to parallel polls by asserting or not asserting the GPIB data line, `dataline`. If `lineSense` equals the individual status (`ist`) bit of the device, then the assigned GPIB data line is asserted during a parallel poll. Otherwise, the data line is not asserted during a parallel poll. The Controller can use parallel polling to obtain 1-bit, device-dependent status messages from up to eight devices simultaneously.

For more information on parallel polling, refer to the NI-488.2M user manual.

Possible Errors

EARG	Either the `address` parameter is invalid, `dataline` is not in the range 1 to 8, or `lineSense` is not 0 or 1. The `address` must be a valid primary/secondary address pair. It cannot be the constant `NOADDR`.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.

PPollConfig (Continued)

PPollConfig

ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

PPollUnconfig

PPollUnconfig

Purpose

Unconfigure devices for parallel polls.

Format

C

```
void PPollUnconfig (int boardID, Addr4882_t *addrlist)
```

Visual Basic

```
CALL PPollUnconfig (boardID%, addrlist%())
```

Input

`boardID`	The interface board number
`addrlist`	A list of device addresses that is terminated by `NOADDR`

Description

`PPollUnconfig` unconfigures all the devices described by `addrlist` for parallel polls. If `addrlist` contains only the constant `NOADDR`, then the Parallel Poll Unconfigure (PPU) GPIB message is sent to all GPIB devices. The devices unconfigured by this function do not participate in subsequent parallel polls.

For more information on parallel polling, refer to the NI-488.2M user manual.

Possible Errors

EARG	An invalid address appears in `addrlist`; `ibcntl` is the index of the invalid address in the `addrlist` array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

RcvRespMsg RcvRespMsg

Purpose

Read data bytes from a device that is already addressed to talk.

Format

C

```
void RcvRespMsg (int boardID, void *buffer, long count,
                 int termination)
```

Visual Basic

```
CALL RcvRespMsg (boardID%, buffer$, termination%)
```

Input

`boardID`	The interface board number
`count`	Number of bytes read
`termination`	Description of the data termination mode (`STOPend` or an 8-bit EOS character)

Output

`buffer`	Stores the received data bytes

Description

`RcvRespMsg` reads up to `count` bytes from the GPIB and places these bytes into `buffer`. Data bytes are read until either `count` data bytes have been read or the termination condition is detected. If the termination condition is `STOPend`, the read is stopped when a byte is received with the EOI line asserted. Otherwise, the read is stopped when the 8-bit EOS character is detected. The actual number of bytes transferred is returned in the global variable, `ibcntl`.

`RcvRespMsg` assumes that the interface board is already in its listen-active state and a device is already addressed to be a Talker (see `ReceiveSetup` or `Receive`).

RcvRespMsg RcvRespMsg
(Continued)

Possible Errors

EABO	The I/O timeout period elapsed before all the bytes were received.
EADR	The interface board is not in the listen-active state; use `ReceiveSetup` to address the GPIB properly.
EARG	The `termination` parameter is invalid. It must be either `STOPend` or an 8-bit EOS character.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

ReadStatusByte ReadStatusByte

Purpose

Serial poll a single device.

Format

C

```
void ReadStatusByte (int boardID, Addr4882_t address,
                     short *result)
```

Visual Basic

```
CALL ReadStatusByte (boardID%, address%, result%)
```

Input

`boardID`	The interface board number
`address`	A device address

Output

`result`	Serial poll response byte

Description

`ReadStatusByte` serial polls the device described by `address`. The response byte is stored in `result`.

Possible Errors

EABO	The device times out instead of responding to the serial poll.
EARG	The `address` parameter is invalid.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

Receive

Purpose

Read data bytes from a device.

Format

C

```
void Receive (int boardID, Addr4882_t address, void *buffer,
              long count, int termination)
```

Visual Basic

```
CALL Receive (boardID%, address%, buffer$, termination%)
```

Input

`boardID`	The interface board number
`address`	Address of a device to receive data
`count`	Number of bytes to read
`termination`	Description of the data termination mode (`STOPend` or an EOS character)

Output

`buffer`	Stores the received data bytes

Description

`Receive` addresses the device described by `address` to talk and the interface board to listen. Then up to `count` bytes are read and placed into the buffer. Data bytes are read until either `count` bytes have been read or the termination condition is detected. If the termination condition is `STOPend`, the read is stopped when a byte is received with the EOI line asserted. Otherwise, the read is stopped when an 8-bit EOS character is detected. The actual number of bytes transferred is returned in the global variable, `ibcntl`.

Receive (Continued) Receive

Possible Errors

EABO	The I/O timeout period elapsed before all the bytes were received.
EARG	The `address` or `termination` parameter is invalid. The `address` must be a valid primary/secondary address pair. It cannot be the constant `NOADDR`.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

ReceiveSetup ReceiveSetup

Purpose

Address a device to be a Talker and the interface board to be a Listener in preparation for `RcvRespMsg`.

Format

C

```
void ReceiveSetup (int boardID, Addr4882_t address)
```

Visual Basic

```
CALL ReceiveSetup (boardID%, address%)
```

Input

`boardID`	The interface board number
`address`	Address of a device to be talk addressed

Description

`ReceiveSetup` makes the device described by `address` talk-active, and makes the interface board listen-active. This call is usually followed by a call to `RcvRespMsg` to transfer data from the device to the interface board. This routine is particularly useful to make multiple calls to `RcvRespMsg`; it eliminates the need to readdress the device to receive every block of data.

Possible Errors

EARG	The `address` parameter is invalid.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

ResetSys ResetSys

Purpose

Reset and initialize IEEE 488.2-compliant devices.

Format

C

```
void ResetSys (int boardID, Addr4882_t *addrlist)
```

Visual Basic

```
CALL ResetSys (boardID%, addrlist%())
```

Input

boardID	The interface board number
addrlist	A list of device addresses that is terminated by NOADDR

Description

The reset and initialization take place in three steps. The first step resets the GPIB by asserting the Remote Enable (REN) line and then the Interface Clear (IFC) line. The second step clears all of the devices by sending the Universal Device Clear (DCL) GPIB message. The final step causes IEEE 488.2-compliant devices to perform device-specific reset and initialization. This step is accomplished by sending the message "*RST\n" to the devices described by addrlist.

Possible Errors

EABO	I/O operation is aborted.
EARG	Either an invalid address appears in addrlist or addrlist is empty; ibcntl is the index of the invalid address in the addrlist array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
ENOL	No Listeners are on the GPIB.
EOIP	Asynchronous I/O is in progress.
ESAC	The board is not System Controller.

Send

Purpose

Send data bytes to a device.

Format

C

```
void Send (int boardID, Addr4882_t address, void *buffer,
           long count, int eotmode)
```

Visual Basic

```
CALL Send (boardID%, address%, buffer$, eotmode%)
```

Input

boardID	The interface board number
address	Address of a device to which data is sent
buffer	The data bytes to be sent
count	Number of bytes to be sent
eotmode	The data termination mode: DABend, NULLend, or NLend

Description

Send addresses the device described by address to listen and the interface board to talk. Then count bytes from buffer are sent to the device. The last byte is sent with the EOI line asserted if eotmode is DABend. The last byte is sent without the EOI line asserted if eotmode is NULLend. If eotmode is NLend then a new line character ('\n') is sent with the EOI line asserted after the last byte of buffer. The actual number of bytes transferred is returned in the global variable, ibcntl.

Possible Errors

EABO	The I/O timeout period has expired before all of the bytes were sent.
EARG	Either the address parameter or eotmode parameter is invalid, or the buffer is empty and eotmode is DABend. The address must be a valid primary/secondary address pair; it cannot be the constant NOADDR. The eotmode parameter can only be DABend, NULLend, or NLend.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.

Send (Continued)

Send

ENOL	No Listeners are on the GPIB to accept the data bytes.
EOIP	Asynchronous I/O is in progress.

SendCmds SendCmds

Purpose

Send GPIB command bytes.

Format

C

```
void SendCmds (int boardID, void *buffer, long count)
```

Visual Basic

```
CALL SendCmds (boardID%, buffer$)
```

Input

boardID	The interface board number
buffer	Command bytes to be sent
count	Number of bytes to be sent

Description

SendCmds sends count command bytes from buffer over the GPIB as command bytes (interface messages). The number of command bytes transferred is returned in the global variable ibcntl. Refer to Appendix A, *Multiline Interface Messages*, for a listing of the defined interface messages.

Use command bytes to configure the state of the GPIB, not to send instructions to GPIB devices. Use Send or SendList to send device-specific instructions.

Possible Errors

EABO	The I/O timeout period expired before all of the command bytes were sent.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
ENOL	No devices are connected to the GPIB.
EOIP	Asynchronous I/O is in progress.

SendDataBytes SendDataBytes

Purpose

Send data bytes to devices that are already addressed to listen.

Format

C

```
void SendDataBytes (int boardID, void *buffer, long count,
                    int eotmode)
```

Visual Basic

```
CALL SendDataBytes (boardID%, buffer$, eotmode%)
```

Input

boardID	The interface board number
buffer	The data bytes to be sent
count	Number of bytes to be sent
eotmode	The data termination mode: DABend, NULLend, or NLend

Description

SendDataBytes sends count number of bytes from the buffer to devices which are already addressed to listen. The last byte is sent with the EOI line asserted if eotmode is DABend; the last byte is sent without the EOI line asserted if eotmode is NULLend. If eotmode is NLend then a new line character ('\n') is sent with the EOI line asserted after the last byte. The actual number of bytes transferred is returned in the global variable, ibcntl.

SendDataBytes assumes that the interface board is in talk-active state and that devices are already addressed as Listeners on the GPIB (see SendSetup, Send, or SendList).

SendDataBytes SendDataBytes

(Continued)

Possible Errors

EABO	The I/O timeout period expired before all of the bytes were sent.
EADR	The interface board is not talk-active; use `SendSetup` to address the GPIB properly.
EARG	Either the `eotmode` parameter is invalid (it can only be `DABend`, `NULLend`, or `NLend`), or the `buffer` is empty and the `eotmode` is `DABend`.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
ENOL	No Listeners are on the GPIB to accept the data bytes; use `SendSetup` to address the GPIB properly.
EOIP	Asynchronous I/O is in progress.

SendIFC SendIFC

Purpose

Reset the GPIB by sending interface clear.

Format

C

```
void SendIFC (int boardID)
```

Visual Basic

```
CALL SendIFC (boardID%)
```

Input

boardID	The interface board number

Description

SendIFC is used as part of GPIB initialization. It forces the interface board to be Controller-In-Charge of the GPIB. It also ensures that the connected devices are all unaddressed and that the interface functions of the devices are in their idle states.

Possible Errors

EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ESAC	The interface board is not configured as the System Controller; see ibrsc.

SendList SendList

Purpose

Send data bytes to multiple GPIB devices.

Format

C

```
void SendList (int boardID, Addr4882_t *addrlist, void *buffer,
               long count, int eotmode)
```

Visual Basic

```
CALL SendList (boardID%, addrlist%(), buffer$, eotmode%)
```

Input

boardID	The interface board number
addrlist	A list of device addresses to send data
buffer	The data bytes to be sent
count	Number of bytes transmitted
eotmode	The data termination mode: DABend, NULLend, or NLend

Description

SendList addresses the devices described by addrlist to listen and the interface board to talk. Then, count bytes from buffer are sent to the devices. The last byte is sent with the EOI line asserted if eotmode is DABend. The last byte is sent without the EOI line asserted if eotmode is NULLend. If eotmode is NLend, then a new line character ('\n') is sent with the EOI line asserted after the last byte. The actual number of bytes transferred is returned in the global variable, ibcntl.

Possible Errors

EABO	The I/O timeout period expired before all of the bytes were sent.
EARG	Either an invalid address appears in addrlist or the addrlist is empty (ibcntl is the index of the invalid address), or the eotmode parameter is invalid. The eotmode parameter can only be DABend, NULLend, or NLend. If the buffer is empty, an eotmode of DABend is disallowed.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.

SendList (Continued)

SendList

ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

SendLLO SendLLO

Purpose

Send the Local Lockout (LLO) message to all devices.

Format

C

```
void SendLLO (int boardID)
```

Visual Basic

```
CALL SendLLO (boardID%)
```

Input

`boardID`	The interface board number

Description

`SendLLO` sends the GPIB Local Lockout (LLO) message to all devices. While Local Lockout is in effect, only the Controller-In-Charge can alter the state of the devices by sending appropriate GPIB messages. `SendLLO` is reserved for use in unusual local/remote situations. In the typical case of placing the devices in Remote With Local Lockout, you should consider `SetRWLS`.

Possible Errors

EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ESAC	The interface board is not configured as System Controller.

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SendSetup SendSetup

Purpose

Set up devices to receive data in preparation for SendDataBytes.

Format

C

```
void SendSetup (int boardID, Addr4882_t *addrlist)
```

Visual Basic

```
CALL SendSetup (boardID%, addrlist%())
```

Input

boardID	The interface board number
addrlist	A list of device addresses that is terminated by NOADDR

Description

SendSetup makes the devices described by addrlist listen-active and makes the interface board talk-active. This call is usually followed by SendDataBytes to actually transfer data from the interface board to the devices. SendSetup is particularly useful to set up the addressing before making multiple calls to SendDataBytes; it eliminates the need to readdress the devices for every block of data.

Possible Errors

EARG	Either an invalid address appears in addrlist or the addrlist is empty; ibcntl is the index of the invalid address in the addrlist array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

SetRWLS SetRWLS

Purpose

Place devices in Remote With Lockout State.

Format

C

```
void SetRWLS (int boardID, Addr4882_t *addrlist)
```

Visual Basic

```
CALL SetRWLS (boardID%, addrlist%())
```

Input

boardID	The interface board number
addrlist	A list of device addresses that is terminated by NOADDR

Description

SetRWLS places the devices described by addrlist in remote mode by asserting the Remote Enable (REN) GPIB line. Then those devices are placed in lockout state by the Local Lockout (LLO) GPIB message. You cannot program those devices locally until the Controller-In-Charge releases the Local Lockout by way of the EnableLocal NI-488.2 routine.

Possible Errors

EARG	Either an invalid address appears in addrlist or the addrlist is empty; ibcntl is the index of the invalid address in the addrlist array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.
ESAC	The interface board is not configured as System Controller.

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TestSRQ TestSRQ

Purpose

Determine the current state of the GPIB Service Request (SRQ) line.

Format

C

```
void TestSRQ (int boardID, short *result)
```

Visual Basic

```
CALL TestSRQ (boardID%, result%)
```

Input

`boardID`	The interface board number

Output

`result`	State of the SRQ line: non-zero if the line is asserted, zero if the line is not asserted

Description

`TestSRQ` returns the current state of the GPIB SRQ line in `result`. If SRQ is asserted, then `result` contains a non-zero value. Otherwise, `result` contains a zero. Use `TestSRQ` to get the current state of the GPIB SRQ line. Use `WaitSRQ` to wait until SRQ is asserted.

Possible Errors

EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.

TestSys TestSys

Purpose

Cause IEEE 488.2-compliant devices to conduct self tests.

Format

C

```
void TestSys (int boardID, Addr4882_t *addrlist,
              short *resultlist)
```

Visual Basic

```
CALL TestSys (boardID%, addrlist%(), resultlist%())
```

Input

`boardID`	The interface board number
`addrlist`	A list of device addresses terminated by `NOADDR`

Output

`resultlist`	A list of test results; each entry corresponds to an address in `addrlist`

Description

`TestSys` sends the "`*TST?`" message to the IEEE 488.2-compliant devices described by `addrlist`. The "`*TST?`" message instructs them to conduct their self-test procedures. A 16-bit test result code is read from each device and stored in `resultlist`. A test result of `0\n` indicates that the device passed its self test. Refer to the manual that came with the device to determine the meaning of the failure code. Any other value indicates that the device failed its self test. If the function returns without an error (that is, the ERR bit is not set in `ibsta`), `ibcntl` contains the number of devices that failed. Otherwise, the meaning of `ibcntl` depends on the error returned. If a device fails to send a response before the timeout period expires, a test result of -1 is repeated for it, and the error EABO is returned.

Possible Errors

EABO	The interface board timed out before receiving a result from a device; `ibcntl` contains the index of the timed-out device. -1 is stored as the test result for the timed-out device.

TestSys (Continued) TestSys

EARG	Either an invalid address appears in `addrlist` or the `addrlist` is empty; `ibcntl` is the index of the invalid address in the `addrlist` array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see `SendIFC`.
EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
ENOL	No Listeners are on the GPIB.
EOIP	Asynchronous I/O is in progress.

Trigger

Purpose

Trigger a device.

Format

C

```
void Trigger (int boardID, Addr4882_t address)
```

Visual Basic

```
CALL Trigger (boardID%, address%)
```

Input

boardID	The interface board number
address	Address of a device to be triggered

Description

Trigger sends the Group Execute Trigger (GET) GPIB message to the device described by address. If address is the constant NOADDR, then the GET message is sent to all devices that are currently listen-active on the GPIB.

Possible Errors

EARG	The address parameter is invalid.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

TriggerList TriggerList

Purpose

Trigger multiple devices.

Format

C

```
void TriggerList (int boardID, Addr4882_t *addrlist)
```

Visual Basic

```
CALL TriggerList (boardID%, addrlist%())
```

Input

boardID	The interface board number
addrlist	A list of device addresses terminated by NOADDR

Description

TriggerList sends the Group Execute Trigger (GET) GPIB message to the devices described by addrlist. If the only address in addrlist is the constant NOADDR, then no addressing is performed and the GET message is sent to all devices that are currently listen-active on the GPIB.

Possible Errors

EARG	An invalid address appears in addrlist; ibcntl is the index of the invalid address in the addrlist array.
EBUS	No devices are connected to the GPIB.
ECIC	The interface board is not the Controller-In-Charge; see SendIFC.
EDVR	Either boardID is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.
EOIP	Asynchronous I/O is in progress.

WaitSRQ WaitSRQ

Purpose

Wait until a device asserts the GPIB Service Request (SRQ) line.

Format

C

```
void WaitSRQ (int boardID, short *result)
```

Visual Basic

```
CALL WaitSRQ (boardID%, result%)
```

Input

`boardID`	The interface board number

Output

`result`	State of the SRQ line: non-zero if line is asserted, zero if line is not asserted

Description

`WaitSRQ` waits until either the GPIB SRQ line is asserted or the timeout period has expired (see `ibtmo`). When `WaitSRQ` returns, `result` contains a non-zero if SRQ is asserted. Otherwise, `result` contains a zero. Use `TestSRQ` to get the current state of the GPIB SRQ line. Use `WaitSRQ` to wait until SRQ is asserted.

Possible Errors

EDVR	Either `boardID` is invalid or the NI-488.2M driver is not installed.
ENEB	The interface board is not installed or is not properly configured.

Chapter 3

Functions for Multithreaded Applications

This chapter lists the extra functions designed for multithreaded applications and describes the purpose, format, and input and output parameters for each function.

For general programming information, refer to the NI-488.2M user manual. The user manual explains how to develop and debug your program. It also describes the example programs included with your NI-488.2M software.

Function Names

The functions in this chapter are listed alphabetically.

Purpose

Each function description includes a brief statement of the purpose of the function.

Format

The format section describes the format of each function in the following languages: Microsoft Visual C/C++ (version 2.0 or higher), Borland C/C++ (version 4.0 or higher), Microsoft Visual Basic (version 4.0 or higher)

Input and Output

The input and output parameters for each function are listed. Function Return describes the return value of the function.

Description

The description section gives details about the purpose and effect of each function.

List of Functions

The following table contains an alphabetical list of the functions for multithreaded applications.

Table 3-1. Functions for Multithreaded Applications

Function	Purpose
ThreadIbcnt	Return the value of the thread-specific ibcnt
ThreadIbcntl	Return the value of the thread-specific ibcntl
ThreadIberr	Return the value of the thread-specific iberr
ThreadIbsta	Return the value of the thread-specific ibsta

ThreadIbcnt ThreadIbcnt

Purpose

Return the value of the thread-specific `ibcnt`.

Format

C

```
int ThreadIbcnt ()
```

Visual Basic

```
rc% = ThreadIbcnt ()
```

Input

none	No input parameters

Output

Function Return	Value of `ibcnt` for the calling thread

Description

`ThreadIbcnt` returns the current value of `ibcnt` for a particular thread of execution. The global GPIB status variables (`ibsta`, `iberr`, `ibcnt`, `ibcntl`) are maintained on a per process basis, which means that their values are updated whenever any thread in that process makes GPIB calls. The thread GPIB status variables are maintained on a per thread basis, which means that their values are updated whenever that particular thread makes GPIB calls. If your application performs GPIB operations in multiple threads, your application should examine the thread GPIB status variables using `ThreadIbsta`, `ThreadIberr`, `ThreadIbcnt`, and `ThreadIbcntl` instead of the global GPIB status variables.

ThreadIbcntl ThreadIbcntl

Purpose

Return the value of the thread-specific ibcntl.

Format

C

```
long ThreadIbcntl ()
```

Visual Basic

```
rc& = ThreadIbcntl ()
```

Input

none	No input parameters

Output

Function Return	Value of ibcntl for the calling thread

Description

ThreadIbcntl returns the current value of ibcntl for a particular thread of execution. The global GPIB status variables (ibsta, iberr, ibcnt, ibcntl) are maintained on a per process basis, which means that their values are updated whenever any thread in that process makes GPIB calls. The thread GPIB status variables are maintained on a per thread basis, which means that their values are updated whenever that particular thread makes GPIB calls. If your application performs GPIB operations in multiple threads, your application should examine the thread GPIB status variables using ThreadIbsta, ThreadIberr, ThreadIbcnt, and ThreadIbcntl instead of the global GPIB status variables.

ThreadIberr

Purpose

Return the value of the thread-specific `iberr`.

Format

C

```
int ThreadIberr ()
```

Visual Basic

```
rc% = ThreadIberr ()
```

Input

none	No input parameters

Output

Function Return	Value of `iberr` for the calling thread

Description

`ThreadIberr` returns the current value of `iberr` for a particular thread of execution. The global GPIB status variables (`ibsta`, `iberr`, `ibcnt`, `ibcntl`) are maintained on a per process basis, which means that their values are updated whenever any thread in that process makes GPIB calls. The thread GPIB status variables are maintained on a per thread basis, which means that their values are updated whenever that particular thread makes GPIB calls. If your application performs GPIB operations in multiple threads, your application should examine the thread GPIB status variables using `ThreadIbsta`, `ThreadIberr`, `ThreadIbcnt`, and `ThreadIbcntl` instead of the global GPIB status variables.

ThreadIbsta ThreadIbsta

Purpose

Return the value of the thread-specific `ibsta`.

Format

C

```
int ThreadIbsta ()
```

Visual Basic

```
rc% = ThreadIbsta ()
```

Input

none	No input parameters

Output

Function Return	Value of `ibsta` for the calling thread

Description

`ThreadIbsta` returns the current value of `ibsta` for a particular thread of execution. The global GPIB status variables (`ibsta`, `iberr`, `ibcnt`, `ibcntl`) are maintained on a per process basis, which means that their values are updated whenever any thread in that process makes GPIB calls. The thread GPIB status variables are maintained on a per thread basis, which means that their values are updated whenever that particular thread makes GPIB calls. If your application performs GPIB operations in multiple threads, your application should examine the thread GPIB status variables using `ThreadIbsta`, `ThreadIberr`, `ThreadIbcnt`, and `ThreadIbcntl` instead of the global GPIB status variables.

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Appendix

A

Multiline Interface Messages

This appendix contains a multiline interface message reference list, which describes the mnemonics and messages that correspond to the interface functions. These multiline interface messages are sent and received with ATN asserted.

For more information on these messages, refer to the ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*.

Table A-1. Multiline Interface Messages

Hex	Dec	ASCII	Msg
00	0	NUL	
01	1	SOH	GTL
02	2	STX	
03	3	ETX	
04	4	EOT	SDC
05	5	ENQ	PPC
06	6	ACK	
07	7	BEL	
08	8	BS	GET
09	9	HT	TCT
0A	10	LF	
0B	11	VT	
0C	12	FF	
0D	13	CR	
0E	14	SO	
0F	15	SI	
10	16	DLE	
11	17	DC1	LLO
12	18	DC2	
13	19	DC3	
14	20	DC4	DCL
15	21	NAK	PPU
16	22	SYN	
17	23	ETB	
18	24	CAN	SPE
19	25	EM	SPD
1A	26	SUB	
1B	27	ESC	
1C	28	FS	
1D	29	GS	
1E	30	RS	
1F	31	US	CFE

Hex	Dec	ASCII	Msg
20	32	SP	MLA0
21	33	!	MLA1
22	34	"	MLA2
23	35	#	MLA3
24	36	$	MLA4
25	37	%	MLA5
26	38	&	MLA6
27	39	'	MLA7
28	40	(	MLA8
29	41	)	MLA9
2A	42	*	MLA10
2B	43	+	MLA11
2C	44	,	MLA12
2D	45	-	MLA13
2E	46	.	MLA14
2F	47	/	MLA15
30	48	0	MLA16
31	49	1	MLA17
32	50	2	MLA18
33	51	3	MLA19
34	52	4	MLA20
35	53	5	MLA21
36	54	6	MLA22
37	55	7	MLA23
38	56	8	MLA24
39	57	9	MLA25
3A	58	:	MLA26
3B	59	;	MLA27
3C	60	<	MLA28
3D	61	=	MLA29
3E	62	>	MLA30
3F	63	?	UNL

(continues)

Multiline Interface Message Definitions

CFE†	Configuration Enable	LLO	Local Lockout
CFG†	Configure	MLA	My Listen Address
DCL	Device Clear	MSA	My Secondary Address
GET	Group Execute Trigger	MTA	My Talk Address
GTL	Go To Local	PPC	Parallel Poll Configure

†This multiline interface message is a proposed extension to the IEEE 488.1 specification to support the HS488 high-speed protocol.

Table A-1. Multiline Interface Messages (Continued)

Hex	Dec	ASCII	Msg
40	64	@	MTA0
41	65	A	MTA1
42	66	B	MTA2
43	67	C	MTA3
44	68	D	MTA4
45	69	E	MTA5
46	70	F	MTA6
47	71	G	MTA7
48	72	H	MTA8
49	73	I	MTA9
4A	74	J	MTA10
4B	75	K	MTA11
4C	76	L	MTA12
4D	77	M	MTA13
4E	78	N	MTA14
4F	79	O	MTA15
50	80	P	MTA16
51	81	Q	MTA17
52	82	R	MTA18
53	83	S	MTA19
54	84	T	MTA20
55	85	U	MTA21
56	86	V	MTA22
57	87	W	MTA23
58	88	X	MTA24
59	89	Y	MTA25
5A	90	Z	MTA26
5B	91	[	MTA27
5C	92	\	MTA28
5D	93	]	MTA29
5E	94	^	MTA30
5F	95	_	UNT
60	96	`	MSA0, PPE
61	97	a	MSA1, PPE, CFG1
62	98	b	MSA2, PPE, CFG2
63	99	c	MSA3, PPE, CFG3
64	100	d	MSA4, PPE, CFG4
65	101	e	MSA5, PPE, CFG5
66	102	f	MSA6, PPE, CFG6
67	103	g	MSA7, PPE, CFG7
68	104	h	MSA8, PPE, CFG8
69	105	i	MSA9, PPE, CFG9
6A	106	j	MSA10, PPE, CFG10
6B	107	k	MSA11, PPE, CFG11
6C	108	l	MSA12, PPE, CFG12
6D	109	m	MSA13, PPE, CFG13
6E	110	n	MSA14, PPE, CFG14
6F	111	o	MSA15, PPE, CFG15
70	112	p	MSA16, PPD
71	113	q	MSA17, PPD
72	114	r	MSA18, PPD
73	115	s	MSA19, PPD
74	116	t	MSA20, PPD
75	117	u	MSA21, PPD
76	118	v	MSA22, PPD
77	119	w	MSA23, PPD
78	120	x	MSA24, PPD
79	121	y	MSA25, PPD
7A	122	z	MSA26, PPD
7B	123	{	MSA27, PPD
7C	124	|	MSA28, PPD
7D	125	}	MSA29, PPD
7E	126	~	MSA30, PPD
7F	127	DEL	

Multiline Interface Message Definitions (Continued)

PPD	Parallel Poll Disable	SPE	Serial Poll Enable
PPE	Parallel Poll Enable	TCT	Take Control
PPU	Parallel Poll Unconfigure	UNL	Unlisten
SDC	Selected Device Clear	UNT	Untalk
SPD	Serial Poll Disable		

Appendix B

Status Word Conditions

This appendix gives a detailed description of the conditions reported in the status word, `ibsta`.

For information about how to use `ibsta` in your application program, refer to Chapter 3, *Developing Your Application*, in the NI-488.2M user manual.

Each bit in `ibsta` can be set for device calls (dev), board calls (brd), or both (dev, brd).

The following table shows the status word layout.

Mnemonic	Bit Pos.	Hex Value	Type	Description
ERR	15	8000	dev, brd	GPIB error
TIMO	14	4000	dev, brd	Time limit exceeded
END	13	2000	dev, brd	END or EOS detected
SRQI	12	1000	brd	SRQ interrupt received
RQS	11	800	dev	Device requesting service
CMPL	8	100	dev, brd	I/O completed
LOK	7	80	brd	Lockout State
REM	6	40	brd	Remote State
CIC	5	20	brd	Controller-In-Charge
ATN	4	10	brd	Attention is asserted
TACS	3	8	brd	Talker
LACS	2	4	brd	Listener
DTAS	1	2	brd	Device Trigger State
DCAS	0	1	brd	Device Clear State

ERR (dev, brd)

ERR is set in the status word following any call that results in an error. You can determine the particular error by examining the error variable `iberr`. Appendix C, *Error Codes and Solutions*, describes error codes that are recorded in `iberr` along with possible solutions. ERR is cleared following any call that does not result in an error.

TIMO (dev, brd)

TIMO indicates that the timeout period has expired. TIMO is set in the status word following any synchronous I/O functions (for example, `ibcmd`, `ibrd`, `ibwrt`, `Receive`, `Send`, and `SendCmds`) if the timeout period expires before the I/O operation has completed. TIMO is also set in the status word following an `ibwait` or `ibnotify` call if the TIMO bit is set in the `mask` parameter and the timeout period expires before any other specified `mask` bit condition occurs. TIMO is cleared in all other circumstances.

END (dev, brd)

END indicates either that the GPIB EOI line has been asserted or that the EOS byte has been received, if the software is configured to terminate a read on an EOS byte. If the GPIB board is performing a shadow handshake as a result of the `ibgts` function, any other function can return a status word with the END bit set if the END condition occurs before or during that call. END is cleared when any I/O operation is initiated.

Some applications might need to know the exact I/O read termination mode of a read operation–EOI by itself, the EOS character by itself, or EOI plus the EOS character. You can use the `ibconfig` function (option `IbcEndBitIsNormal`) to enable a mode in which the END bit is set only when EOI is asserted. In this mode if the I/O operation completes because of the EOS character by itself, END is not set. The application should check the last byte of the received buffer to see if it is the EOS character.

SRQI (brd)

SRQI indicates that a GPIB device is requesting service. SRQI is set whenever the GPIB board is CIC, the GPIB SRQ line is asserted, and the automatic serial poll capability is disabled. SRQI is cleared either when the GPIB board ceases to be the CIC or when the GPIB SRQ line is unasserted.

RQS (dev)

RQS appears in the status word only after a device-level call and indicates that the device is requesting service. RQS is set whenever one or more positive serial poll response bytes have been received from the device. A positive serial poll response byte always has bit 6 asserted. Automatic serial polling must be enabled (it is enabled by default) for RQS to automatically appear in `ibsta`. You can also wait for a device to request service regardless of the state of automatic serial polling by calling `ibwait` with a mask that contains RQS. Do not issue an `ibwait` call on RQS for a device that does not respond to serial polls. Use `ibrsp` to acquire the serial poll response byte that was received. RQS is cleared when all of the stored serial poll response bytes have been reported to you through the `ibrsp` function.

CMPL (dev, brd)

CMPL indicates the condition of I/O operations. It is set whenever an I/O operation is complete. CMPL is cleared while the I/O operation is in progress.

LOK (brd)

LOK indicates whether the board is in a lockout state. While LOK is set, the `EnableLocal` routine or `ibloc` function is inoperative for that board. LOK is set whenever the GPIB board detects that the Local Lockout (LLO) message has been sent either by the GPIB board or by another Controller. LOK is cleared when the System Controller unasserts the Remote Enable (REN) GPIB line.

REM (brd)

REM indicates whether or not the board is in the remote state. REM is set whenever the Remote Enable (REN) GPIB line is asserted and the GPIB board detects that its listen address has been sent either by the GPIB board or by another Controller. REM is cleared in the following situations:

- When REN becomes unasserted
- When the GPIB board as a Listener detects that the Go to Local (GTL) command has been sent either by the GPIB board or by another Controller
- When the `ibloc` function is called while the LOK bit is cleared in the status word

CIC (brd)

CIC indicates whether the GPIB board is the Controller-In-Charge. CIC is set when the `SendIFC` routine or `ibsic` function is executed either while the GPIB board is System Controller or when another Controller passes control to the GPIB board. CIC is cleared either when the GPIB board detects Interface Clear (IFC) from the System Controller or when the GPIB board passes control to another device.

ATN (brd)

ATN indicates the state of the GPIB Attention (ATN) line. ATN is set whenever the GPIB ATN line is asserted, and it is cleared when the ATN line is unasserted.

TACS (brd)

TACS indicates whether the GPIB board is addressed as a Talker. TACS is set whenever the GPIB board detects that its talk address (and secondary address, if enabled) has been sent either by the GPIB board itself or by another Controller. TACS is cleared whenever the GPIB board detects the Untalk (UNT) command, its own listen address, a talk address other than its own talk address, or Interface Clear (IFC).

LACS (brd)

LACS indicates whether the GPIB board is addressed as a Listener. LACS is set whenever the GPIB board detects that its listen address (and secondary address, if enabled) has been sent either by the GPIB board itself or by another Controller. LACS is also set whenever the GPIB board shadow handshakes as a result of the `ibgts` function. LACS is cleared whenever the GPIB board detects the Unlisten (UNL) command, its own talk address, Interface Clear (IFC), or that the `ibgts` function has been called without shadow handshake.

DTAS (brd)

DTAS indicates whether the GPIB board has detected a device trigger command. DTAS is set whenever the GPIB board, as a Listener, detects that the Group Execute Trigger (GET) command has been sent by another Controller. DTAS is cleared on any call immediately following an `ibwait` call, if the DTAS bit is set in the `ibwait` mask parameter.

DCAS (brd)

DCAS indicates whether the GPIB board has detected a device clear command. DCAS is set whenever the GPIB board detects that the Device Clear (DCL) command has been sent by another Controller, or whenever the GPIB board as a Listener detects that the Selected Device Clear (SDC) command has been sent by another Controller.

If you use the `ibwait` or `ibnotify` function to wait for DCAS and the wait is completed, DCAS is cleared from `ibsta` after the next GPIB call. The same is true of reads and writes. If you call a read or write function such as `ibwrt` or `Send`, and DCAS is set in `ibsta`, the I/O operation is aborted. DCAS is cleared from `ibsta` after the next GPIB call.

Appendix C

Error Codes and Solutions

This appendix lists a description of each error, some conditions under which it might occur, and possible solutions.

The following table lists the GPIB error codes.

Error Mnemonic	iberr Value	Meaning
EDVR	0	System error
ECIC	1	Function requires GPIB board to be CIC
ENOL	2	No Listeners on the GPIB
EADR	3	GPIB board not addressed correctly
EARG	4	Invalid argument to function call
ESAC	5	GPIB board not System Controller as required
EABO	6	I/O operation aborted (timeout)
ENEB	7	Nonexistent GPIB board
EDMA	8	DMA error
EOIP	10	Asynchronous I/O in progress
ECAP	11	No capability for operation
EFSO	12	File system error
EBUS	14	GPIB bus error
ESTB	15	Serial poll status byte queue overflow
ESRQ	16	SRQ stuck in ON position
ETAB	20	Table problem

EDVR (0)

EDVR is returned when the board or device name passed to `ibfind`, or the board index passed to `ibdev`, cannot be accessed. The global variable `ibcntl` contains an error code. This error occurs when you try to access a board or device that is not installed or configured properly.

EDVR is also returned if an invalid unit descriptor is passed to any NI-488 function call.

Solutions

- Use `ibdev` to open a device without specifying its symbolic name.
- Use only device or board names that are configured in the GPIB configuration utility as parameters to the `ibfind` function.
- Use the GPIB Configuration utility to ensure that each board you want to access is configured properly.
- Use the unit descriptor returned from `ibdev` or `ibfind` as the first parameter in subsequent NI-488 functions. Examine the variable before the failing function to make sure its value has not been corrupted.
- For Windows 95, refer to the *Troubleshooting EDVR Error Conditions* section in Appendix C, *Windows 95: Troubleshooting and Common Questions*, in the NI-488.2M user manual for more information.

ECIC (1)

ECIC is returned when one of the following board functions or routines is called while the board is not CIC:

- Any device-level NI-488 functions that affect the GPIB
- Any board-level NI-488 functions that issue GPIB command bytes: `ibcmd`, `ibcmda`, `ibln`, and `ibrpp`
- `ibcac` and `ibgts`
- Any of the NI-488.2 routines that issue GPIB command bytes: `SendCmds`, `PPoll`, `Send`, and `Receive`

Solutions

- Use `ibsic` or `SendIFC` to make the GPIB board become CIC on the GPIB.
- Use `ibrsc 1` to make sure your GPIB board is configured as System Controller.
- In multiple CIC situations, always be certain that the CIC bit appears in the status word `ibsta` before attempting these calls. If it does not appear, you can perform an `ibwait` (for CIC) call to delay further processing until control is passed to the board.

ENOL (2)

ENOL usually occurs when a write operation is attempted with no Listeners addressed. For a device write, ENOL indicates that the GPIB address configured for that device in the software does not match the GPIB address of any device connected to the bus, that the GPIB cable is not connected to the device, or that the device is not powered on.

ENOL can occur in situations where the GPIB board is not the CIC and the Controller asserts ATN before the write call in progress has ended.

Solutions

- Make sure that the GPIB address of your device matches the GPIB address of the device to which you want to write data.
- Use the appropriate hex code in `ibcmd` to address your device.
- Check your cable connections and make sure at least two-thirds of your devices are powered on.
- Call `ibpad` (or `ibsad`, if necessary) to match the configured address to the device switch settings.
- Reduce the write byte count to that which is expected by the Controller.

EADR (3)

EADR occurs when the GPIB board is CIC and is not properly addressing itself before read and write functions. This error is usually associated with board-level functions.

EADR is also returned by the function `ibgts` when the shadow-handshake feature is requested and the GPIB ATN line is already unasserted. In this case, the shadow handshake is not possible and the error is returned to notify you of that fact.

Solutions

- Make sure that the GPIB board is addressed correctly before calling `ibrd`, `ibwrt`, `RcvRespMsg`, or `SendDataBytes`.
- Avoid calling `ibgts` except immediately after an `ibcmd` call. (`ibcmd` causes ATN to be asserted.)

EARG (4)

EARG results when an invalid argument is passed to a function call. The following are some examples:

- `ibtmo` called with a value not in the range 0 through 17.
- `ibeos` called with meaningless bits set in the high byte of the second parameter.
- `ibpad` or `ibsad` called with invalid addresses.
- `ibppc` called with invalid parallel poll configurations.
- A board-level NI-488 call made with a valid device descriptor, or a device-level NI-488 call made with a board descriptor.
- An NI-488.2 routine called with an invalid address.
- `PPollConfig` called with an invalid data line or sense bit.

Solutions

- Make sure that the parameters passed to the NI-488 function or NI-488.2 routine are valid.
- Do not use a device descriptor in a board function or vice-versa.

ESAC (5)

ESAC results when `ibsic`, `ibsre`, `SendIFC`, or `EnableRemote` is called when the GPIB board does not have System Controller capability.

Solutions

Give the GPIB board System Controller capability by calling `ibrsc 1` or by using the GPIB configuration utility to configure that capability into the software.

EABO (6)

EABO indicates that an I/O operation has been canceled, usually due to a timeout condition. Other causes are calling `ibstop` or receiving the Device Clear message from the CIC while performing an I/O operation. Frequently, the I/O is not progressing (the Listener is not continuing to handshake or the Talker has stopped talking), or the byte count in the call which timed out was more than the other device was expecting.

Solutions

- Use the correct byte count in input functions or have the Talker use the END message to signify the end of the transfer.
- Lengthen the timeout period for the I/O operation using `ibtmo`.
- Make sure that you have configured your device to send data before you request data.

ENEB (7)

ENEB occurs when no GPIB board exists at the I/O address specified in the configuration program. This problem happens when the board is not physically plugged into the system, the I/O address specified during configuration does not match the actual board setting, or there is a system conflict with the base I/O address.

Solutions

Make sure there is a GPIB board in your computer that is properly configured both in hardware and software using a valid base I/O address.

EDMA (8)

EDMA occurs if a system DMA error is encountered when the NI-488.2M software attempts to transfer data over the GPIB using DMA.

Solutions

- You can correct the EDMA problem in the hardware by using the GPIB configuration utility to reconfigure the hardware to not use a DMA resource.
- You can correct the EDMA problem in the software by using `ibdma` to disable DMA.

EOIP (10)

EOIP occurs when an asynchronous I/O operation has not finished before some other call is made. During asynchronous I/O, you can only use `ibstop`, `ibnotify`, `ibwait`, and `ibonl` or perform other non-GPIB operations. If any other call is attempted, EOIP is returned.

Solutions

Resynchronize the driver and the application before making any further GPIB calls. Resynchronization is accomplished by using one of the following functions:

- `ibnotify` If the `ibsta` value passed to the `ibnotify` callback contains CMPL, the driver and application are resynchronized.
- `ibwait` If the returned `ibsta` contains CMPL then the driver and application are resynchronized.
- `ibstop` The I/O is canceled; the driver and application are resynchronized.
- `ibonl` The I/O is canceled and the interface is reset; the driver and application are resynchronized.

ECAP (11)

ECAP results when your GPIB board lacks the ability to carry out an operation or when a particular capability has been disabled in the software and a call is made that requires the capability.

Solutions

Check the validity of the call, or make sure your GPIB interface board and the driver both have the needed capability.

EFSO (12)

EFSO results when an `ibrdf` or `ibwrtf` call encounters a problem performing a file operation. Specifically, this error indicates that the function is unable to open, create, seek, write, or close the file being accessed. The specific operating system error code for this condition is contained in `ibcntl`.

Solutions

- Make sure the filename, path, and drive that you specified are correct.
- Make sure that the access mode of the file is correct.
- Make sure there is enough room on the disk to hold the file.

EBUS (14)

EBUS results when certain GPIB bus errors occur during device functions. All device functions send command bytes to perform addressing and other bus management. Devices are expected to accept these command bytes within the time limit specified by the default configuration or the `ibtmo` function. EBUS results if a timeout occurred while sending these command bytes.

Solutions

- Verify that the instrument is operating correctly.
- Check for loose or faulty cabling or several powered-off instruments on the GPIB.

- If the timeout period is too short for the driver to send command bytes, increase the timeout period.

ESTB (15)

ESTB is reported only by the `ibrsp` function. ESTB indicates that one or more serial poll status bytes received from automatic serial polls have been discarded because of a lack of storage space. Several older status bytes are available; however, the oldest is being returned by the `ibrsp` call.

Solutions

- Call `ibrsp` more frequently to empty the queue.
- Disable autopolling with the `ibconfig` function (option `IbcAUTOPOLL`) or the GPIB configuration utility.

ESRQ (16)

ESRQ can only be returned by a device-level `ibwait` call with RQS set in the mask. ESRQ indicates that a wait for RQS is not possible because the GPIB SRQ line is stuck on. This situation can be caused by the following events:

- Usually, a device unknown to the software is asserting SRQ. Because the software does not know of this device, it can never serial poll the device and unassert SRQ.
- A GPIB bus tester or similar equipment might be forcing the SRQ line to be asserted.
- A cable problem might exist involving the SRQ line.

Although the occurrence of ESRQ warns you of a definite GPIB problem, it does not affect GPIB operations, except that you cannot depend on the `ibsta` RQS bit while the condition lasts.

Solutions

Check to see if other devices not used by your application are asserting SRQ. Disconnect them from the GPIB if necessary.

ETAB (20)

ETAB occurs only during the `FindLstn` and `FindRQS` functions. ETAB indicates that there was some problem with a table used by these functions.

- In the case of `FindLstn`, ETAB means that the given table did not have enough room to hold all the addresses of the Listeners found.
- In the case of `FindRQS`, ETAB means that none of the devices in the given table were requesting service.

Solutions

In the case of `FindLstn`, increase the size of result arrays. In the case of `FindRQS`, check to see if other devices not used by your application are asserting SRQ. Disconnect them from the GPIB if necessary.

Appendix D

Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

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National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call (512) 795-6990. You can access these services at:

United States: (512) 794-5422
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 1 48 65 15 59
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FTP Support

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Fax-on-Demand is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access Fax-on-Demand from a touch-tone telephone at (512) 418-1111.

E-Mail Support (currently U.S. only)

You can submit technical support questions to the applications engineering team through e-mail at the Internet address listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

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Canada (Quebec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	09 527 2321	09 502 2930
France	01 48 14 24 24	01 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Israel	03 5734815	03 5734816
Italy	02 413091	02 41309215
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	5 520 2635	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
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U.K.	01635 523545	01635 523154

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___)_____ Phone (___)_____

Computer brand _____ Model _____ Processor _____

Operating system (include version number _____

Clock Speed _____MHz RAM _____MB Display adapter _____

Mouse _____yes _____no Other adapters installed _____

Hard disk capacity _____MB Brand _____

Instruments used _____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is _____

_____

_____

_____

List any error messages _____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

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Glossary

Prefix	Meaning	Value
n-	nano-	10-9
µ-	micro-	10-6
m-	milli-	10-3
k-	kilo-	10^3
M-	mega-	10^6

A

acceptor handshake — Listeners use this GPIB interface function to receive data, and all devices use it to receive commands. See *source handshake* and *handshake*.

access board — The GPIB board that controls and communicates with the devices on the bus that are attached to it.

ANSI — American National Standards Institute.

ASCII — American Standard Code for Information Interchange.

asynchronous — An action or event that occurs at an unpredictable time with respect to the execution of a program.

automatic serial polling (autopolling) — A feature of the NI-488.2M software in which serial polls are executed automatically by the driver whenever a device asserts the GPIB SRQ line.

B

base I/O address	See *I/O address*.
BIOS	Basic Input/Output System.
board-level function	A rudimentary function that performs a single operation.

C

CFE (Configuration Enable)	The GPIB command which precedes CFGn and is used to place devices into their configuration mode.
CFGn	These GPIB commands (CFG1 through CFG15) follow CFE and are used to configure all devices for the number of meters of cable in the system so that HS488 transfers occur without errors.
CIC (Controller-In-Charge)	The device that manages the GPIB by sending interface messages to other devices.
CPU	Central processing unit.

D

DAV (Data Valid)	One of the three GPIB handshake lines. See *handshake*.
DCL (Device Clear)	The GPIB command used to reset the device or internal functions of all devices. See SDC.
device-level function	A function that combines several rudimentary board operations into one function so that the user does not have to be concerned with bus management or other GPIB protocol matters.
DIO1 through DIO8	The GPIB lines that are used to transmit command or data bytes from one device to another.
DLL	Dynamic link library.
DMA (direct memory access)	High-speed data transfer between the GPIB board and memory that is not handled directly by the CPU. Not available on some systems. See *programmed I/O*.
driver	Device driver software installed within the operating system.

E

END or END Message	A message that signals the end of a data string. END is sent by asserting the GPIB End or Identify (EOI) line with the last data byte.
EOI	A GPIB line that is used to signal either the last byte of a data message (END) or the parallel poll Identify (IDY) message.
EOS or EOS Byte	A 7- or 8-bit end-of-string character that is sent as the last byte of a data message.
EOT	End of transmission
ESB	The Event Status bit is part of the IEEE 488.2-defined status byte which is received from a device responding to a serial poll.

G

GET (Group Execute Trigger)	Group Execute Trigger is the GPIB command used to trigger a device or internal function of an addressed Listener.
GPIB	General Purpose Interface Bus is the common name for the communications interface system defined in ANSI/IEEE Standard 488.1-1987 and ANSI/IEEE Standard 488.2-1992.
GPIB address	The address of a device on the GPIB, composed of a primary address (MLA and MTA) and perhaps a secondary address (MSA). The GPIB board has both a GPIB address and an I/O address.
GPIB board	Refers to the National Instruments family of GPIB interface boards.
GTL (Go To Local)	Go To Local is the GPIB command used to place an addressed Listener in local (front panel) control mode.

H

handshake	The mechanism used to transfer bytes from the Source Handshake function of one device to the Acceptor Handshake function of another device. The three GPIB lines DAV, NRFD, and NDAC are used in an interlocked fashion to signal the phases of the transfer, so that bytes can be sent asynchronously (for example, without a clock) at the speed of the slowest device. For more information about handshaking, refer to the ANSI/IEEE Standard 488.1-1987.

hex	Hexadecimal; a number represented in base 16. For example, decimal 16 = hex 10.
high-level function	See *device-level function*.
Hz	Hertz.

I

`ibcnt`	After each NI-488 I/O function, this global variable contains the actual number of bytes transmitted.
`iberr`	A global variable that contains the specific error code associated with a function call that failed.
`ibsta`	At the end of each function call, this global variable (status word) contains status information.
IEEE	Institute of Electrical and Electronic Engineers.
interface message	A broadcast message sent from the Controller to all devices and used to manage the GPIB.
I/O (Input/Output)	In the context of this manual, the transmission of commands or messages between the computer via the GPIB board and other devices on the GPIB.
I/O address	The address of the GPIB board from the point of view of the CPU, as opposed to the GPIB address of the GPIB board. Also called port address or board address.
`ist`	An Individual Status bit of the status byte used in the Parallel Poll Configure function.

K

KB	Kilobytes.

L

LAD (listen address)	See *MLA*.

language interface	Code that enables an application program that uses NI-488 functions or NI-488.2 routines to access the driver.
Listener	A GPIB device that receives data messages from a Talker.
LLO (Local Lockout)	The GPIB command used to tell all devices that they may or should ignore remote (GPIB) data messages or local (front panel) controls, depending on whether the device is in local or remote program mode.
low-level function	A rudimentary board or device function that performs a single operation.

M

m	Meters.
MAV	The Message Available bit is part of the IEEE 488.2-defined status byte which is received from a device responding to a serial poll.
MB	Megabytes of memory.
memory-resident	Resident in RAM.
MLA (My Listen Address)	A GPIB command used to address a device to be a Listener. It can be any one of the 31 primary addresses.
MSA (My Secondary Address)	The GPIB command used to address a device to be a Listener or a Talker when extended (two byte) addressing is used. The complete address is a MLA or MTA address followed by an MSA address. There are 31 secondary addresses for a total of 961 distinct listen or talk addresses for devices.
MTA (My Talk Address)	A GPIB command used to address a device to be a Talker. It can be any one of the 31 primary addresses.
multitasking	The concurrent processing of more than one program or task.

N

NDAC (Not Data Accepted)	One of the three GPIB handshake lines. See *handshake*.
NRFD (Not Ready For Data)	One of the three GPIB handshake lines. See *handshake*.

P

parallel poll	The process of polling all configured devices at once and reading a composite poll response. See *serial poll*.
PIO	See *programmed I/O*.
PPC (Parallel Poll Configure)	Parallel Poll Configure is the GPIB command used to configure an addressed Listener to participate in polls.
PPD (Parallel Poll Disable)	Parallel Poll Disable is the GPIB command used to disable a configured device from participating in polls. There are 16 PPD commands.
PPE (Parallel Poll Enable)	Parallel Poll Enable is the GPIB command used to enable a configured device to participate in polls and to assign a DIO response line. There are 16 PPE commands.
PPU (Parallel Poll Unconfigure)	Parallel Poll Unconfigure is the GPIB command used to disable used to disable any device from participating in polls.
programmed I/O	Low-speed data transfer between the GPIB board and memory in which the CPU moves each data byte according to program instructions. See *DMA*.

R

RAM	Random-access memory.
resynchronize	The NI-488.2M software and the user application must resynchronize after asynchronous I/O operations have completed.
RQS	Request Service.

S

s	Seconds.
SDC (Selected Device Clear)	The GPIB command used to reset internal or device functions of an addressed Listener. See *DCL*.
serial poll	The process of polling and reading the status byte of one device at a time. See *parallel poll*.

service request	See *SRQ*.
source handshake	The GPIB interface function that transmits data and commands. Talkers use this function to send data, and the Controller uses it to send commands. See *acceptor handshake* and *handshake*.
SPD (Serial Poll Disable)	The GPIB command used to cancel an SPE command.
SPE (Serial Poll Enable)	The GPIB command used to enable a specific device to be polled. That device must also be addressed to talk. See *SPD*.
SRQ (Service Request)	The GPIB line that a device asserts to notify the CIC that the device needs servicing.
status byte	The IEEE 488.2-defined data byte sent by a device when it is serially polled.
status word	See *ibsta*.
synchronous	Refers to the relationship between the NI-488.2M driver functions and a process when executing driver functions is predictable; the process is blocked until the driver completes the function.
System Controller	The single designated Controller that can assert control (become CIC of the GPIB) by sending the Interface Clear (IFC) message. Other devices can become CIC only by having control passed to them.

T

TAD (Talk Address)	See *MTA*.
Talker	A GPIB device that sends data messages to Listeners.
TCT (Take Control)	The GPIB command used to pass control of the bus from the current Controller to an addressed Talker.
timeout	A feature of the NI-488.2M driver that prevents I/O functions from hanging indefinitely when there is a problem on the GPIB.
TLC	An integrated circuit that implements most of the GPIB Talker, Listener, and Controller functions in hardware.

U

ud (unit descriptor)	A variable name and first argument of each function call that contains the unit descriptor of the GPIB interface board or other GPIB device that is the object of the function.
UNL (Unlisten)	The GPIB command used to unaddress any active Listeners.
UNT (Untalk)	The GPIB command used to unaddress an active Talker.

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